SCIENTIFIC AMERICAN

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The Park Row Building, New York.

Height, 390 feet; number of stories, 29; depth of foundations, 54 feet; height from bottom of foundations to top of flagpole, 501 feet; number of offices, 950; estimated number of occupants, 4,000; number of windows, 2,095; total weight, 20,000 tons; cost, $2,400,000.

THE TALLEST OF THE MODERN OFFICE BUILDINGS.—[See page 409.]

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NEW YORK, SATURDAY, DECEMBER 24, 1898.

ENGLISH AND AMERICAN MACHINE TOOLS.

It will be remembered that one of the principal grounds of contention during the great strike in the British engineering trades was the question as to the right of the trades unions to control the output of labor-saving machinery. Happily for the interests of both employers and employed, the attempt of the men to limit the output of machinery was thwarted.

In a recent editorial on English and American machine tools, The Engineer comments on the fact that the English manufacturer is at length beginning to recognize that the restriction in the way of their use being now removed, automatic machine tools are of great importance. Our esteemed contemporary expresses regret that English makers of machine tools do not devote more effort to the design and manufacture of automatic machine tools, and goes on to say: "Is it possible that English manufacturers cannot find time to devote some attention to this class of machinery, and so offer battle to the increasing competition, or is it that they still profess to despise American methods? If the latter is the case they would do well to undeceive themselves by an inspection of American machines. We have frequently heard it stated that the imported article was weak and roughly made. A few years ago that was to a great extent true, but it is so no longer. American engineers do not stand still, and they have eagerly learned by experience. The consequence is that their tools are nowadays at least as stoutly built as our own and are as well finished, while in accessibility of their working parts, in ingenious automatic devices, in adaptation for rapid work, in convenience and handiness, they are far ahead of the productions of most British firms."

The Engineer has no intention of "puffing" American productions, but speaks plainly, with the hope of "removing some of the bias" which misguides the British manufacturers; and it points out to its readers that our success is due largely to the fact that instead of waiting for customers to state what is wanted, our manufacturers have a way of taking the initiative in improvements; "they lead, and do not follow manufacture."

These are candid words and full of remarkable significance, coming, as they do, from the most conservative technical journal in Great Britain; and if the British manufacturer fails to take the hint, it can never be his excuse that his loss of a profitable trade was due to ignorance of the underlying cause.

SAFETY OF THE BROOKLYN BRIDGE.

The public has lately been favored with somewhat conflicting statements regarding the strength and safety of the Brooklyn Suspension Bridge, made by two engineers whose names are prominently associated with the construction and maintenance of this great structure. The first appeared in the form of a letter to The Railroad Gazette from W. A. Roebling, who, after the death of John A. Roebling, superintended the construction of the bridge; the second statement is the report of C. C. Martin, the present chief engineer of the bridge, to Bridge Commissioner Shea.

Mr. Roebling, referring to the recent buckling of the stiffening trusses, attributes it entirely to the presence of the overfloor stays. In our issue of August 13, 1898, there will be found a discussion of the accident, in which the buckling is attributed solely to these stays, which extend from the panel points of the trusses to a rigid connection with the top of the towers. Mr. Roebling states that in any future suspension bridge he would dispense with their use, and explains they were retained by him because, on account of the increased loads which were to be placed on the bridge, "long before the cables were completed" he "had to look in every direction for an increase in supporting power." "The crying evil on the bridge," says Mr. Roebling, "is that every year since it has been opened for traffic there have been numerous additions to the dead load, the climax of the overloading" being "reached when the trolley took possession of the roadways." The builder of the bridge has no fear for the cables, as they still have ample strength and "could pull up the anchorages with ease."

Mr. Martin's report, while it gives much valuable information as to the strength of the cables and the stability of the anchorages, has little to say about the failure of that part of the bridge that aroused the present discussion, namely, the stiffening trusses. While it is, no doubt, a fact that the bridge is "absolutely safe," and "no one need entertain for a moment any fears of its stability," it is nevertheless true that the stiffening trusses are altogether unequal to the demand of a sudden emergency, and that as far as they are concerned the bridge is not "stable." Since the stiffening truss is an integral part of a suspension bridge, it follows that the failure of the trusses is a failure of the bridge, and hence a bridge in which these trusses are liable to collapse under a congestion of traffic which may occur at any time, is obviously overloaded. All that can be said of the bridge is that under its present loading it is liable to a partial failure, which will not, however, involve any risk to the traffic that passes over it.

The report states that the total moving load upon the main span is 1,962 tons, the total additional weight added in the way of new tracks, cables, electric cables, trolley arms and traces, etc., is 430 tons, and the weight of the original superstructure is 5,828 tons, thus bringing the total weight up to 8,220 tons. This multiplied by 1·7 gives a total strain in the cables of 13,974 tons. The ultimate strength of the four cables, however, is 49,200 tons, which gives a factor of safety of 3·52. It is argued that since the dead weight of the structure cannot be materially increased, any increase must come from the moving load, which must, therefore, be multiplied ten times over before it could break the cables.

The stability of the anchorages is shown by the fact that they have moved forward under the pull of the cables only one-eighth of an inch in the past eight years.

The report will allay any fears that may have been entertained by the public as to the danger of a positive collapse of the bridge. Neither the floor, the suspenders, the cables, nor the anchorages can give way under any increase of loads that can be brought upon the bridge. The stiffening trusses have failed more than once and they will fail again whenever a blockade occurs on the bridge. The best thing to be done would be to remove the superfluous diagonal stays, which were one of the conducing causes of the buckling, and replace the present flimsy and inefficient stiffening trusses by others of greater depth and weight. If this were done, we should hear no more of alarmist rumors of buckling floor system or collasping cables, and the bridge would be good for its natural life of twenty centuries.

ELECTRIC LOCOMOTIVES FOR EUROPE.

An American corporation, the General Electric Company, has recently obtained a contract for the supply of the equipment for the tunnel of the Paris-Orleans Railway, from its present terminus in Paris at the Austerlitz station to a new station near the Quai d'Orsay, in the heart of the city. The manager of the foreign department of the company said: "Although this contract involves a smaller amount of money than the contracts secured some months ago from the London Underground Railway, it is in quality, so to speak, a more important contract, for it marks the conquest of the stubborn French prejudice against American manufactures, and against too ready an adoption of the latest improvements, waiting as they are prone to do for something better still. Moreover, the contract was won against the strongest possible competition of British and European companies during a period of negotiation extending over two years. We have contracted to furnish eight electric locomotives operated with the third rail, and that they will more than fulfill all expectations we do not for a moment doubt." It has not been decided whether the third rail will be between or outside the tracks. The system of transmission will require the use of the three-phase generators for the rotary converters, changing an alternating to a direct current of 500 volts. There were fourteen competitors in the matter of the Paris contract. French engineers were taken over to the United States and a complete demonstration was given on their experimental track at Schenectady, and the company's ability to do more than was required was shown. There is a railway of considerable length at Schenectady following the course of the Mohawk River, and on this railway a train of more weight than that of the Paris-Orleans line was run backward and forth over a distance equal to that between the stations of the Paris tunnel. The perfect mobility and power of the electric locomotive was so well shown that the French engineers were immediately convinced that it met all of the conditions in even a higher degree than had been demanded. The fact that the American company could show the greatest experience in electrical locomotive building was of far more importance than the question of cost. The only point considered was, which of the competitors could supply the most efficient locomotive and accompanying electrical apparatus. This is certainly another triumph for American engineers.

BREAKDOWN IN DAILY NEWSPAPER OFFICES DUE TO LACK OF GAS.

The bursting of a large gasometer, which is referred to elsewhere in this issue, was the cause of trouble and inconvenience to the newspapers which use the linotype machines, owing to the fact that the supply of gas down town was cut off. In the linotype machine the type metal is kept hot by gas, so that when the gas pressure became reduced the type metal began to cool. In most of the machines there was no gas at all, and in the few in which it did burn, the flame was very feeble. Several of the papers had to set up their type by hand, and in one case twenty machines had to be abandoned. At least one newspaper which does not use machines courteously placed the composing room at the service of another paper. It is probable that after this newspapers will provide some means for heating the type metal in case the supply of gas is temporarily cut off, and devices of this nature are made.

HAVANA'S FLOATING DRY DOCK.

On the recommendation of the American Evacuation Commission of Havana, our government will not insist that the floating dry dock of the Spanish navy in Havana Harbor shall be turned over to the United States. Admiral Sampson endeavored to persuade his colleagues that the dock was not movable property and therefore must be surrendered by Spain. Generals Wade and Butler, however, held that the dock was a floating and movable structure. Both parties were right in a way, for $40,000 was expended for establishing it in its present berth, and the fact that it cannot be moved was cited by Admiral Sampson in support of his contention. We have already illustrated this dock in the SCIENTIFIC AMERICAN for October 16, 1897.

The dock was built in England and cost the Spanish government $600,000. It reached Havana a short time before the war began and was promptly sunk, which is not to be wondered at, considering that we know now that the Spaniards are the poorest mechanics in the world. The American commission say it has been so badly used it is not worth more than half what it cost. It is probable the dock will be put up at public auction by the Spaniards and sold, as the American commissioners and Spanish commissioners have failed to agree on a price.

SCIENTIFIC CONVENTIONS IN NEW YORK DURING THE HOLIDAYS.

Eleven associations of scientists will hold their winter meetings in this city during the week succeeding Christmas, and all are to be the guests of Columbia University. The programmes offered by the various associations are full of interest and are certain to attract many professional men to the meetings. The American Chemical Society will hold its meeting on Tuesday and Wednesday, December 27 and 28. The morning session of the first day will be held at the Chemists' Club, 108 West Fifty-fifth Street, and will be devoted to the hearing of addresses and the reading and discussion of papers, but the afternoon will be used in visiting the works of the New Jersey Zinc Company, at Newark. The second day will be given up to the reading of papers and the examination of the chemical laboratories in Havemeyer Hall, of Columbia University. On Wednesday and Thursday come the gatherings of the American Society of Naturalists, the American Morphological Society, the Association of American Anatomists, the American Physiological Society, the American Psychological Association, the American Folk Lore Society, the Society for Plant Morphology and Physiology, the Anthropological Section of the American Association for the Advancement of Science, and the Geological Society of America, while the New York State Science Teachers' Association will meet on Thursday and Friday.

Wednesday will be devoted to the business sessions of the various societies and the reading of papers, morning and afternoon, in Schermerhorn and Fayerweather Halls and the College of Physicians and Surgeons. In the evening there will be a lecture at the American Museum of Natural History, by Prof. H. F. Osborn, on "Collections of Fossil Mammals and Their Care," followed by a reception to the members of the societies, at the home of Prof. Osborn. Thursday morning and afternoon will be given up to the solid work of reading and discussing of papers, the set topic for 3 P. M., with the naturalists, being "Advances in Methods of Teaching." The programme for Friday includes visits to the Botanical and Zoological Gardens for the naturalists, while the geologists and the science teachers will still be occupied with the reading and discussion of papers. In connection with the meeting of the Science Teachers' Association there is to be an exhibition of scientific apparatus at the Teachers' College on West One Hundred and Twentieth Street. The president of the Chemical Society is Prof. Charles E. Munroe, that of the Naturalists' is Prof. H. P. Bowditch, and that of the Geologists' is Prof.

J. J. Stevenson, while the chairman of the local executive committee of the affiliated societies is Prof. H. F. Osborn and its secretary is Prof. Bashford Dean.

FLYING MACHINES AND ORDNANCE.*

BY HIRAM MAXIM.

FLYING MACHINES.

In 1889 I determined to make a series of experiments with a view of ascertaining how much power was required to perform artificial flight on a large scale. All the apparatus made before this time had been so diminutive in size, so imperfect in construction, that the experiments were of little value. There were practically no data obtainable that would apply to the apparatus when constructed on a sufficiently large scale to be considered as a practical flying machine.

At that time it appeared to me that the most practical system of making flying machines would be what is known as the aeroplane system, that is, a machine made in the form of a kite.

Every boy knows that, when a kite is held up against a strong wind by a cord, it will ascend. The wind, blowing against the underneath surface of the kite, lifts it with a considerable degree of force; conversely, if the kite should be driven forward through stationary air at the same velocity, the lifting effect would be identical.

My first apparatus consisted of a long arm revolving on a vertical pivot, the arm being of sufficient length so that the circumference around which it traveled was exactly 200 feet. This arm was provided with a screw propeller and it was possible to attach aeroplanes of any size or shape at any required angle, and to drive them around the circle at any velocity from 20 to 90 miles an hour. The apparatus was provided with tachometers, dynamometers, and various apparatus not only for determining the lifting effect of the aeroplanes, but also the actual amount of power required to propel the plane through the air; to measure the thrust and slip of the screw; also the amount of power required for driving the screw, and to determine exactly the velocity at which the apparatus was traveling.

The aeroplanes employed in this apparatus were for the most part about 18 inches wide and 4 feet long. Wooden aeroplanes with lightly curved surfaces were found to be best. These experiments demonstrated that 133 pounds could be lifted and propelled at the rate of 45 miles an hour with the expenditure of 1 H. P. I then constructed a very large apparatus, which was, of course, too large to attach to the rotating arm, the apparatus, in fact, being over 100 feet wide. I determined to try this machine by running it along a railway track; that is, instead of running the machine in a circle or holding it up against the wind after the manner of a kite, I decided to run it at a high velocity along a railway track, and to provide it with apparatus to determine the amount of power consumed and the lifting effect of the aeroplanes. First, I had a steel track 9 feet gage, and outside of this and above it a wooden track 35 feet gage, made of 3 inch by 9 inch Georgia pine. The machine was provided with ordinary wheels for running on the lower steel track, and with special wheels for running on the underneath side of the outer or upper track. The wheels were adjusted in such a manner that when the machine was lifted 1 inch clear of the lower track, the special wheels engaged the outer or upper track, thus preventing the machine from rising in the air.

In these experiments the power consumed was altogether out of proportion to what I had anticipated. Had my large machine been as economical as the small apparatus, it would only have required 100 H. P. to lift it, but 100 H. P. was found to be completely inadequate, and it was not until I had increased the power to over 360 H. P. that I succeeded in getting a machine actually to lift from the ground.

These experiments demonstrated that large machines are nothing like so economical in power as small ones, and that aeroplanes, in order to be effective at a moderate velocity, should be long and narrow, rather than in the form of a kite.

Prof. Langley has constructed an apparatus similar to mine, but very much smaller, and he found that, with his apparatus, the power required per pound lifted was very much less than with my large machine, approximating closely to the original experiments made by myself with the small apparatus.

I understand that the government is spending $25,000 with a view of evolving a practical flying machine. I do not think they will succeed on the aeroplane system. I believe that, when we come to large apparatus, it will be necessary to construct a machine on a totally different plan. Moreover, the $25,000 will be found completely inadequate for the purpose, as my own experiments cost fully $100,000.

My experiments have been fully explained in various articles which I have written, which knowledge is now common property.

FIREARMS AND ORDNANCE.

During the last three hundred years the cleverest mechanicians of all countries have been engaged in making improvements in firearms, always with a view of greater accuracy and rapidity of fire, but it was not until metallic cartridges came into use that it was possible to construct breechloading firearms which could be fired with any degree of rapidity.

It is, however, true that long before metallic cartridges were invented, several attempts were made to construct rapid-fire machine guns. It was, I think, in about 1840 when the great Peter Cooper made what was perhaps the first machine gun ever thought of in this country. In 1854 my own father conceived the idea of making a machine gun. He proposed to make it something after the manner of a revolver, but instead of having loaded chambers, a sprocket wheel took the place of the cylinder, and this was supposed to feed up loaded links of a chain, bring them in line with the barrel and discharge them by the working of a lever by hand. He believed it would be possible to make a gun of this kind that would fire one hundred rounds in a minute. Curiously enough, the gun which was experimented on by Peter Cooper, and the one conceived by my father, of which I made a wooden model, were almost exactly alike.

The first machine gun that ever went into practical use was the Gatling. The Gatling gun had a series of from six to ten barrels arranged in the form of a cylinder, and so constructed that when one turns a crank by hand the barrels are brought successively into action. Then we had the French mitrailleuse, which had thirty stationary barrels arranged in the form of a cylinder. All of these were loaded and fired simultaneously, and the recoil was so great that the gun had to be provided with a mounting quite as strong as would be employed with light pieces of artillery. Later on we had the Gardner, the Lowell, the Pratt & Whitney, and the Nordenfeldt, all being provided with a considerable number of barrels arranged in groups, with hopper feeds, and in all cases being worked by hand by means of a crank or lever. The Nordenfeldt gun, on account of greater simplicity and lightness, met with greater success than the other types of hand-operated guns, but none of these guns were used to any extent by the great military nations of Europe, and it was not until after the automatic gun was invented that such nations as Germany, France, and Austria would even consider the use of machine guns in the service.

Many years ago, while firing at a target with a military musket, I was much surprised at the force of the recoil. It appeared to me on that occasion that this waste of energy might be profitably employed in loading and firing the arm, but it was not until I went to Europe, and, finding myself in Paris, with insufficient work to keep me fully employed, that I actually took up the question of automatic guns. I first made a drawing which I afterward took to London, and having obtained and equipped a small factory there, I commenced experiments with a view of evolving a gun which would load and fire itself. There was not a particle of data to go by. No one before had ever spent a single cent in experimenting with automatic guns. I first thought of applying the recoil to working existing forms of mechanism, but found that impractical. I then designed and constructed a totally new mechanism and a totally new system of feeding.

In the spring of 1884 I constructed the first apparatus ever made in the world in which the recoil of one cartridge would load another cartridge into the barrel and fire it. This apparatus is now in the South Kensington Museum, in London, and labeled "This apparatus loads and fires itself by force of its own recoil, and is the first apparatus ever made in the world in which energy from the burning powder is employed for loading and firing the arm."

When it was first reported in London that an American electrician had succeeded in making a gun which had loaded and fired itself, everyone was incredulous; they looked upon it as Yankee brag or boast. Many people came to my place and wished to see the gun with their own eyes.

I had fitted up a place in the basement where a gun could be fired with loaded cartridges, and my visitors increased daily. Everybody, from the Prince of Wales down, came to see what was then considered a nine days' wonder, and it required a very considerable portion of my time to receive visitors and show the arm; in fact, so much of my time was consumed that it became necessary to work nights in order to carry on the work and take out the patents in the various countries of the world.

I used fully 200,000 rounds of cartridges showing my first gun to visitors. The British government was the first to give me an order. They asked me to make a gun which would not weigh more than 100 pounds, and which should fire 400 rounds in a minute. I presented a gun which weighed only 40 pounds and fired 2,000 rounds in three minutes. At these trials I showed three different forms of automatic guns, and all were purchased by the government and are now in their museum.

The next step was to take the gun on the Continent and put it in competition with guns working by hand. In every case I was successful over all competitors, and received large orders. On returning to England I had a field trial before Lord Wolseley. Every one admitted the superiority of the arm, both as regards accuracy, simplicity, and ease of manipulation, but his lordship said, on observing the enormous cloud of smoke given off by the gun, that the gun would be of little use in actual service unless it was provided with smokeless powder. At that time there was no smokeless powder in England, although the French were conducting experiments with the view of finding a smokeless powder.

Acting on his lordship's suggestions, I then commenced experiments with a view of making a suitable smokeless powder for my gun. The first powder which I made was pure tri-nitro-cellulose, made from high grade gun cotton. This not proving altogether satisfactory, I added by degrees small quantities of nitro-glycerine, commencing with about 5 per cent and increasing until I actually made a successful powder with as much as 60 per cent of nitro-glycerine; but as there was great prejudice against the use of nitro-glycerine, I reduced the quantity to about 13 per cent and produced a thoroughly good smokeless powder. Both nitro-glycerine and high grade gun cotton are violent explosives; in fact, they detonate like a fulminating cap. Nobel, before my time, had attempted to tame or slow up nitro-glycerine by the addition of a sluggish explosive, like collodion cotton, but no one had attempted to make a slow-burning powder from two violent explosives.

Sir Richard Webster, in the celebrated case of Nobel v. Government, admitted that I was the first man in the world to make smokeless powder from nitro-glycerine and gun cotton. It was, I think, about nine years ago that I sent a quantity of this powder to this country. It was in competition with many other kinds of smokeless powder. It produced excellent results, and, according to the official report printed at that time, it was superior to any other powder submitted, and to-day it may be said that little or no improvement has been made in this original powder submitted by me at that time. The powder employed by the government to-day is practically of the same composition and the pressures and velocities are also practically the same.

A few years later the French, wishing to obtain a little higher velocity with an automatic gun than it was possible to obtain with the French powder, proposed to increase the length of the cartridge case, but I suggested that they might attain the desired velocities with the use of an improved form of powder. I accordingly made in England a quantity of smokeless powder with longitudinal perforations. I took it to France and produced results better than ever produced before. I attained the required velocities without increasing the size of the cartridge case, and the gun with the new form of powder was adopted into the French service.

[At the close of the lecture a fully automatic gun loaded with blank cartridges was fired in the lecture hall, at the rate of six hundred rounds a minute.

Mr. Maxim repeated this lecture before the American Society of Civil Engineers, at their club house, No. 220 West 57th Street, on the evening of December 14, and was enthusiastically received. It should be mentioned that he accompanied the lecture with numerous lantern slide illustrations of his aeroplane and ordnance factory.—ED.]

* Address delivered before the Engineering Society of Columbia University of the City of New York, December 8, 1898.

COST OF CLEANING BRICK PAVEMENTS.

The organ of the New York Reform Club Committee, Municipal Affairs, published quarterly, has, in its last issue, a very interesting and complete report upon the reforms effected in cleaning the streets of the city. By this it is shown that the ease with which certain types of pavement can be kept clean, as indicated by careful observations of the cost of doing the work, is as follows: Asphalt, 100; brick, 100; wood (smooth karri), 100; granite, 150; Belgian blocks, 160; cobble stones, 400.

All the pavements were in good condition and the accuracy of the table was checked by comparison with the number of sweepers actually employed in each subdivision in the city. For the entire city 1,623 sweepers were employed, each sweeper keeping clean an average of 5,746 square yards, at an average cost of $2.40 per 1,000 square yards a week; indicating, according to the estimate, that asphalt, brick, and smooth karri wood paving could be kept clean at 69 cents per 1,000 yards per week.

A brick pavement, when properly laid, is not a noisy pavement, it is a good and smooth road for traction purposes or for bicycling, while it affords a better foothold for horses than asphalt does, it is more than ten times as durable, it is lower in first cost, incomparably lower in cost of maintenance, and the New York report proves incontestably that, in the important matter of cleaning, the brick pavement is in no way inferior to asphalt; therefore, we cannot understand why the vitrified brick pavement is not universally adopted in all our cities.

AN INGENIOUS WATER-DISTILLING APPARATUS.

Water, we are frequently told, constitutes a most important component of our food. It is evident, therefore, that care should be taken to purify the water which we drink, and to remove all the organisms with which it may be charged. To this end some apparatus must be employed whereby the dangerous microbes can be destroyed and the water rendered potable. Such an apparatus is found in a still made by the Cupigraph Company, 138 North Green Street, Chicago, Ill.

The still in question comprises essentially a retort and a condenser. The retort occupies the lower portion of the apparatus and receives the water to be distilled. The condenser is carried in the upper portion of the still, is made tapering in form, and has a conical bottom through which an overflow pipe passes. Water is poured into the funnel at the top of the still, and, after having filled the condenser, passes into the overflow pipe into the retort below.

The steam generated by heating the water in the retort rises, and, coming into contact with the water-filled condenser above, is condensed and trickles into an annular reservoir in the manner shown. The condensation of the steam produces a partial vacuum, which is filled by air conducted from the outside by means of tubes. As the tubes are surrounded partially by hot distilled water and partially by steam, the inrushing air is sterilized before mingling with the products of condensation. The distilled water is, hence, impregnated with oxygen having its organic life destroyed.

The retort or lower chamber has a capacity of two gallons; the distilled water reservoir, a capacity of one gallon. Since the surplus water in the uppermost reservoir will overflow into the lower chamber, it follows that the still cannot readily boil dry.

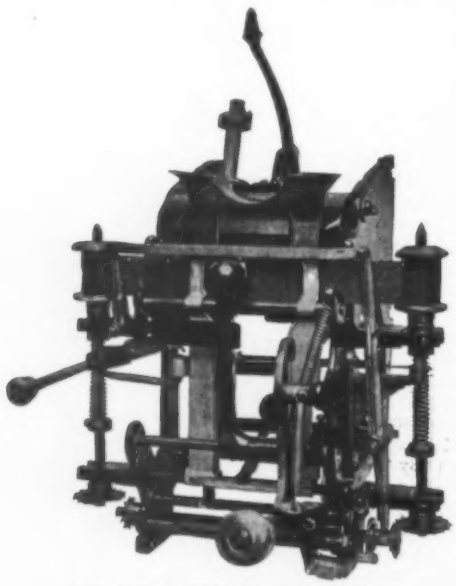
In order that the water-level may be easily ascertained, the retort and reservoir are provided with gage-glasses.

The noteworthy features of this apparatus are the large cold area obtained by the tapering form and conical bottom of the condenser, the inclosed reservoir protected from contact with the atmosphere, the method of providing pure oxygen to the condensed steam, and the means for preventing the still's boiling dry.

AN INGENIOUS WATER-DISTILLING APPARATUS.

THE "ROCHESTER" SYSTEM OF TIME-RECORDING.

In many of the mechanical time-recorders used by the owners of large factories and mills for the purpose



THE TIME-PRINTING MECHANISM.

of registering the number of hours in which their employés have worked, long tapes are employed, upon which the time of each employé's coming and going is recorded. Admirable as these apparatus may be, mechanically considered, they nevertheless necessitate a vast amount of labor in transcribing the confused records made upon the tape and in the subsequent calculation of wages. In a new system of time-recording which is widely coming into use, the tape has been dispensed with, and in its stead a card-system is employed, which, for ingenuity and simplicity, leaves nothing to be desired. The system in question is used in connection with the "Rochester" time-recorder, made by the Willard & Frick Manufacturing Company, of Rochester, N. Y.

The cards employed are ruled and printed in the manner shown in one of our engravings, so as to provide for the recording of the time of arrival and the time of departure of every employé, for the total number of hours worked, and for the wages corresponding with the time recorded. The time-printing apparatus employed is located in the lower part of a clock-casing, ed on independent sleeves fitted on a stationary arbor, one wheel being numbered from 1 to 60 and the other from 1 to 12. In front of the type wheels an inked ribbon is passed, which is brought into contact with the hour and minute type-wheels by means of a hammer carried by a pivoted frame and operated by a lever projecting from the front of the casing at the right hand side. As in many typewriters, the ribbon is automatically shifted from side to side. The card-holder is provided, not with a stationary bottom, but with a movable abutment which limits the distance to which the card can be inserted, and which is automatically operated by a lifting rod in order to be raised every twelve hours by an amount equal to the distance of one vertical space on the card. By means of a shifting lever projecting from the front of the casing at the left hand side, the card-receiver may be moved laterally.

The time-printing apparatus is operated by a Seth Thomas clock having the usual gear-trains and springs. The shaft carrying the hands of the clock drives the type-wheels below, through the medium of beveled

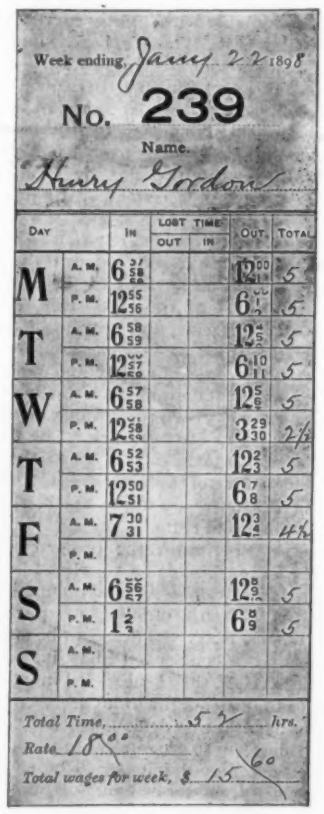
THE RECORDER AND CLOCK.

gears and a connecting rod. A rotary cam mounted on the hour shaft causes the card-receiver abutment to be moved upwardly through one vertical space, thus bringing the card into proper position for A. M. or P. M. records and preventing the workman from recording the time during which he was absent the previous day. The abutment is dropped to its lowermost position once every week by means of the cam.

In connection with the recording mechanism two racks are employed, one of which receives the cards after the time of beginning work has been recorded and the other after the time of departure has been registered. Upon beginning work, each employé takes his card from its rack, places it in the card-receiver, and presses the printing lever down, thereby causing the hammer to press the card against the ribbon and the type-wheels. As the record is made, a bell connected with the lever sounds, thus informing the workman that his time of arrival has been registered. He then removes the card, and, after verifying the record, places it in the other rack. After having finished his daily work, the time of departure is recorded and the card again placed in the first-named rack. By glancing over the racks it can be immediately ascertained how many men are present and how many are absent.

The cards used in the "Rochester" system can be so ruled that not only the hours worked during the day can be recorded, but also the time spent upon a single article. The back of the card shown can be ruled in such a manner that the time consumed in working upon various articles can be entered, and the times thus noted must correspond with those printed by the recorder. The hours during which a man has labored upon a single piece may be registered by the recorder itself, if need be. So elastic is this system that, even though a workman labors by the hour and partly by the piece, cards can still be provided which shall meet these requirements. The system can therefore be adapted to any form of wage payment.

The simplicity of this time-recording system, its trustworthiness, the accuracy of its records, coupled with the small amount of clerical labor necessary to compute the wages, have induced the Franklin Insti-



A "ROCHESTER" TIME-CARD.

tute to award it the John Scott medal and the gold premium.

The system has been adopted for use in the United States Treasury Department and its branches and by many prominent manufacturers throughout the world.

AN exhaustive examination of compounds of selenium and tellurium has been carried out by R. Metzner. In the case of tellurium he was able to redetermine the atomic weight by two different methods: (1) by the use of tellurium sulphate; (2) by the reduction of tellurous acid with carbon monoxide in presence of silver. He gives the atomic weight of tellurium as 127·9. Among the various new compounds which the author has prepared are two hydrates of selenic acid, well crystallized selenious sulphate, two oxyfluorides and the fluoride of tellurium, a hydrate of hydrofluoric acid, and a compound of tellurium bichloride and phosphorus perchloride. Methods are also given for preparing large quantities of selenic acid, either by electrolyzing seleniate of copper or by oxidizing selenious acid by means of permanganic acid.—Ann. de Chim. et de Phys., xv., 203.

EQUIPMENT OF THE BROADWAY CABLE LINE WITH ELECTRICITY.

In recent issues of the SCIENTIFIC AMERICAN we have described at considerable length the important changes which are being made in the great system of surface roads owned and operated by the Metropolitan Street Railway Company. These changes include the construction of four important north and south lines of railway on the underground trolley system on Second, Fourth, Sixth, and Eighth Avenues, with connecting cross lines at Fifty-ninth and Canal Streets, the changing of the Broadway and Lexington Avenue lines from the cable to the underground trolley system, and the equipment of a crosstown line from the Hudson to the East River with compressed air motors. When the work which the company has now in hand is completed, 90 miles out of the total of 228½ miles owned by the company will be mechanically operated. In the course of time it is intended to apply electric traction to the whole system, with the exception of some crosstown roads. If the use of the compressed air motor on the Twenty-third Street line shows good results, it will be adopted on other crosstown lines.

1.—LAYING DUCTS FOR ELECTRICAL EQUIPMENT OF BROADWAY CABLE ROAD.

The electric roads are entirely new construction, the old horse car tracks having been removed in toto to make way for the cast iron yokes and massive 107-pound rails which are the standard construction for all the new electric roads. On the Broadway road, on the other hand, the whole of the original track construction is available, and the changes are confined to laying of the cable ducts and bolting the conductor rails to the lower flanges of the slot rails within the conduit.

The ducts are laid in a trench which is excavated at the side of the tracks and slightly under them, as shown in the accompanying illustration, Fig. 1. Two kinds of duct are used, one consisting of riveted sheet iron pipe about 4 inches in diameter, lined internally with cement, forming the top layer of twenty pipes, the other being made of terra cotta in short lengths of about 2 feet.

The object of these numerous ducts is to carry independent conductors to different sections of the road, providing current in case of accident to one section, to all the others reducing to a minimum the possibility of delay on long stretches of road at a time.

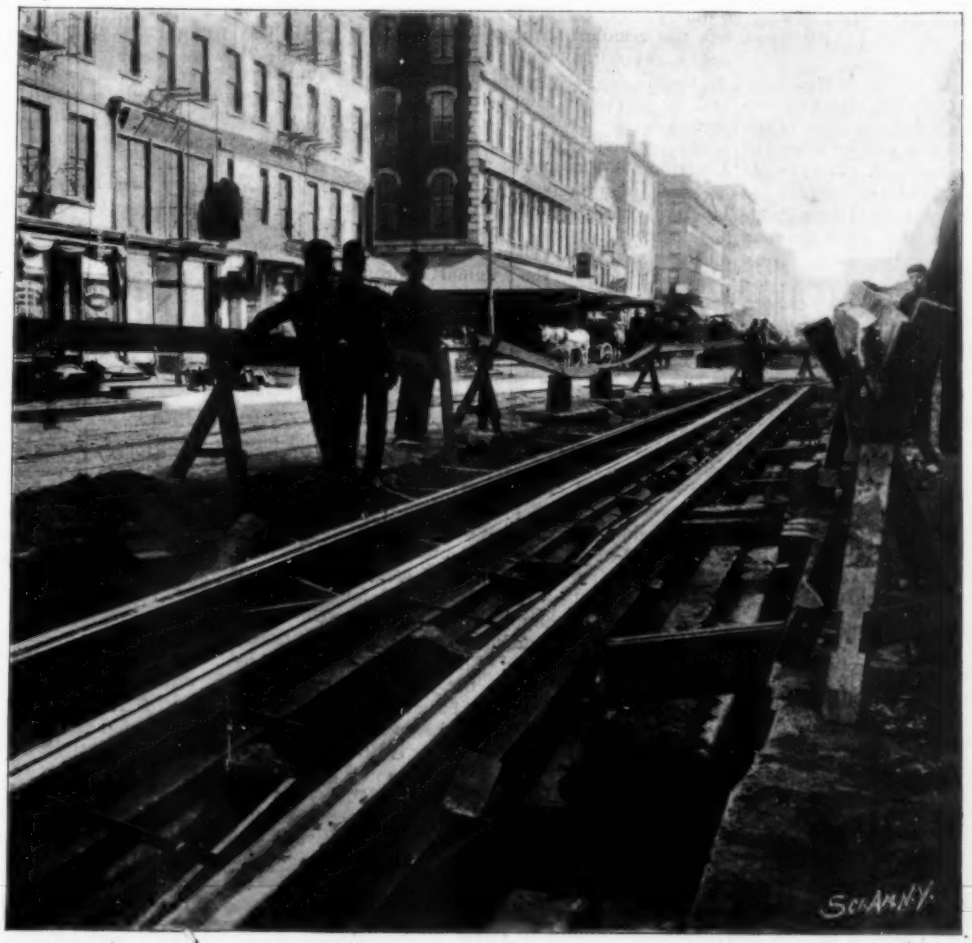
The terra cotta ducts are preferred for the high tension current cables. In laying the ducts, the bottom of the trench is leveled and covered with from 4 to 6 inches of concrete. The ducts are then arranged symmetrically in layers and cement grout is run in between them to fill up the voids and bind the whole mass together. The sides and top are also concreted in, thus insuring that the continuity of the several lines of duct shall be preserved unbroken. Piles of these ducts will be observed on the sidewalk to the left ready to be placed in position. This work of transformation is going on without the least interruption to the regular cable traffic.

The conductors consist of two lines of T-shaped rail weighing 21 pounds to the yard, which are suspended below the cable slot by means of insulators attached to the lower flanges of the slot rails. The insulator consists of a circular cast iron cup, provided with lugs by which it is bolted to the slot rails. Within this cup is another of porcelain, which is held firmly within the cast iron cup by cement. The porcelain cup holds a 1¼-inch wrought iron shank to which the conductor T-rail is bolted.

To enable the conductor rails and their supports to be put in place, two handhole boxes are being placed, one on each side of the slot, at every 15 feet of the Broadway track. The conductor rails will be in 30 foot lengths, so that it will be possible to slide them into the conduit at the handholes. They will be supported at the ends and at the middle. After the insulators and conductors have been passed in through the handholes and bolted up and the wiring to the cables in the ducts completed, the Broadway road will be ready for the electric cars, which will commence running early in 1899.

The present Broadway cars can be utilized by equipping them with motors, and replacing the present grip by an electric plow. It is probable, however, that new and larger cars of the type at work on the present electric roads of the company will be supplied for this, the most important artery of travel in New York city.

In the underground trolley system as now being installed the track rails play no part in the electric circuit. The current is conveyed to and from the motor by means of the plow, one side of the plow receiving the current from the feed conductor and the other side delivering it to the return conductor. The shank of the plow consists of three steel plates, the outer plates being ⅛ inch and the inner plate $\frac{3}{16}$ inch in thickness. The conductors, which are wrapped copper ribbons, are carried down through the plow to the contact shoes or wipers, connection being made between them by flexible cables. The shoes are of cast iron and measure 4 inches by ½ inch. They are kept in contact with the conductor rails by means of side steel springs which keep the shoes 8 inches apart when free and 6 inches apart when they are in contact with the conductor rails. It has been found that a pressure of about 6 pounds is sufficient to insure good electrical contact between shoes and conductors.



2.—CONSTRUCTION OF NEW UNDERGROUND TROLLEY ROAD ON CANAL STREET, NEW YORK CITY.

The engraving, Fig. 2, shows a portion of the new underground trolley road in course of construction in Canal Street. Under the slot is seen the sheet iron drain tube and to the right another form of terra cotta ducts, each section having four tubes about 6 feet long. By comparing it with the view of the Broadway road it will be seen that the new track is considerably heavier. The rails, weighing 107 pounds to the yard, are not only the most massive used in any street railway, but they are several pounds heavier than the largest rails used on the steam railroads, where the most massive rails do not exceed 100 pounds to the yard. This is the weight of the rails on main line of the New York, New Haven, and Hartford Railroad and on certain stretches of the New York Central and the Pennsylvania Railroads.

Current for the whole of the underground system,

including the Broadway line, is eventually to be furnished from one great central station at Ninety-sixth Street and the East River. It will have a capacity of 70,000 horsepower, or over four times that of any existing power station in this country. The plant will consist of 87 water-tube boilers of 800 horsepower each; 11 cross-compound engines, each of 6,600 horsepower; and 11 direct connected three-phase alternating current generators. The current, at 6,000 volts, will be led to 8 substations, conveniently located with reference to the various lines. Here it will be converted by static and rotary converters to a pressure of 550 volts, at which it will pass to the conductors.

Military Firearms.

The military attachés of the United States army abroad report, says The New York Post, that a number of foreign countries have decided in favor of the adoption of the Spanish Mauser rifle, as a result of the showing made in the Spanish-American war. According to the information received, the following countries will use the Mauser rifle exclusively: Turkey, Argentine Republic, Chile, Mexico, Sweden, and Brazil. The only country to take up the Krag-Jorgensen rifles is Norway. Several of the first named countries were ordering a limited number of the Mauser rifles before last summer, but the decision to adopt this arm exclusively has, in a number of cases, been only lately reached. Brazil, Chile, and Mexico will employ the caliber of 0·276-inch; Turkey and the Argentine Republic have decided upon the caliber 0·301-inch. Sweden will use a caliber of 0·256-inch. The Krag-Jorgensen adopted by Norway will have a caliber of 0·256 inch. The caliber of the United States arm is 0·30-inch.

The Loewe works at Berlin have the orders for the majority of the Spanish Mausers. It was this establishment which first developed the gun, and the Spanish army was partially equipped with weapons made at the German works and partly at the arsenal at Oviedo, Spain. The Spanish Mauser is an improved Belgian Mauser. The gun is essentially a German weapon, the term "Spanish" being applied to the model which was adopted by the Spanish government. The gun is held to be free from objectionable features which characterize most magazine arms and it is considered by military men on the Continent to be the best army weapon in existence.

The militia and volunteers of Canada are now equipped with the Lee-Enfield magazine gun, which is an improvement on the Lee-Metford now in the hands of the British line regiments. The Lee-Enfield has but five grooves and the Lee-Metford seven, and the rifling is sharper and the depth of the grooves is increased from 0·003-inch to 0·005-inch. The alterations in the gun were largely caused by the erosive effect of cordite. One of the new rifles has been fired 13,000 times and still gives good results.

The Chief of the Bureau of Ordnance of the Navy Department, Captain Charles O'Neil, is making every effort to secure a common caliber for the guns of the army and navy of the United States, and he is backed in the matter by many ordnance experts. The present navy gun has a caliber of 0·236-inch. While the weapon gives splendid ballistic results, it is not a favorite for rough service. The necessity for a common caliber gun is almost too evident for discussion. Thus, while the vessels of Rear Admiral Dewey may have their magazines filled with cartridges of 0·276 caliber, yet these cartridges are useless to our troops in the Philippines should the latter run short of cartridges. The joint board appointed to consider the subject has just reported favorably, but does not deem an immediate change of vital importance.

Something About the Chinch Bug.

The United States Department of Agriculture has in press and will soon issue Bulletin No. 15, Division of Entomology, entitled "The Chinch Bug." The chinch bug is one of the most destructive insects with which the American farmer has to contend, and the department receives many requests for information about it. This bulletin is intended to meet this demand, and gives many new facts concerning the life history and distribution of the species, and the whole subject of the practical handling of its diseases in order to assist in its destruction is treated at length. It says few insects have caused such pecuniary losses as the chinch bug, and no other insect native to the western hemisphere has spread its devastating hordes over a wider area of the country with more fatal effect to the staple grains of North America. It is widely distributed over the world and hibernates in the adult stage. It is of gregarious habits and migrates in spring, summer and autumn. The bulletin states that it would appear that this pest first made its presence known in this country in North Carolina in 1783, and mentions several serious outbreaks of the bug in the West, the estimated losses from its ravages from 1850 to 1887 reaching $267,000,000. It also says that it is believed that the losses up to 1898 amounted to fully $330,000,000.

Science Notes.

Some interesting experiments on the velocity of sound were recently made by M. Frot, near Bourges. Two sets of experiments gave for the velocity in air at 0° C. mean results of 330·6 and 330·9 meters per second. The times were measured automatically by electric chronographs.

As is well known to botanists, but not so well known to the general public, says Prof. C. E. Bessey in Science, the white powdery coating on some leaves and fruits is waxy in nature and is called "bloom" in technical works on botany. Its function has received some attention, Mr. Darwin having made it the object of some studies in his later years. In a recent number of The Laboratory Bulletin, of Oberlin College, is a short paper by Miss Roberta Reynolds, giving the results of a series of experiments which show that when the bloom is removed from the epidermis the transpiration of water is greatly increased. Thus in case of Agave utahensis the loss was about two and a half times as much from the leaf which was without bloom as from that with the bloom. It was observed, also, that on damp days the difference between the leaves was less than on dry days; so, too, there was less difference in the case of young leaves than when old ones were used.

Medical statistics of the American-Spanish war, as reported by the Surgeon-General of the United States Army, stands as follows: From May to September, inclusive, and representing an army of 167,168 men, there were reported in full 1,715 deaths. Of this number, 640 were due to typhoid fever, 97 to malarial fevers, and 363 to diarrhea and dysentery. The death rates of May and June—0·46 and 0·70—were not in excess of those of the army in peace times; in July the rate reached 2·15 for the month, or 25·80 per 1,000, which does not much exceed that of well-cared-for cities. But in August the rate became excessive, or 4·08 per month, or 48·96 per 1,000 per year. In September the conditions improved and the death rate fell to 2·45, or 29·40 per year. The records of the civil war show that a high death rate in August was generally continued for months after, and Dr. Sternberg ascribes the improvement noted in September to the stricter sanitary measures adopted.

"The fate which he dreaded has already overtaken Luccheni," says The British Medical Journal, November 5. "The criminal anthropologists have naturally marked the murderer of the Empress of Austria for their own as a subject of scientific study. The corpus vile of the criminal will doubtless be reserved for Prof. Lombroso or some expert of equal rank, but in the meantime some eager investigators have been studying photographs of Luccheni. To the eye of the ordinary observer he looks a commonplace ruffian, but the criminal anthropologists, we are assured, at once see even in a photograph complete asymmetry of the body. Amyotrophy of the face, neck, trunk, arm, and leg on the left side is very marked. These stigmata are the consequences of grave cerebrospinal lesions occurring in infancy, and due to heredity, alcoholic atavism, misère physiologique, or some disease of infancy, perhaps an encephalomyelitis or lateral sclerosis, from which complete recovery never took place. Luccheni is pronounced to be a type of the asymmétrique déséquilibré. It would have been more satisfactory if the criminal anthropologists could have recognized all these evidences of criminality before Luccheni had perpetrated the crime which has given him the notoriety of infamy which he coveted."

To speak of a color-blind artist sounds like joking, said a noted London oculist; but strange as it seems, there are several persons so affected who can nevertheless paint extremely well. Numbers of color-blind people there are, of course, who draw perfectly in pencil, ink, and crayons, but I myself know a scene painter attached to a provincial theater who, though "color-blind," paints all its scenery, and has quite a local name, not only for his "interiors" and oak chambers, but even for landscapes. I can tell you also of two London ladies who consulted me for color-blindness who paint really beautiful pictures. One is the daughter of a late famous artist, and was taught painting by her father. She is quite unable to distinguish red from green, but her colors are labeled with the names, and she has been taught which to use for certain effects. Possibly her painting may seem to her eyes, as it were, drawing with a brush and "shading" with the colors. The other is a lady artist of some celebrity, who has for years exhibited annually in London. The public are not aware that she is color-blind. She painted the "Wedding Group" for a certain noble bridegroom a year or two ago, and also several public men's portraits, and one of an eminent physician fetched 500 guineas. There is a gentleman residing at Kensington who, having years ago left the navy through finding his advancement hopelessly barred by his color-blindness, is at present making several hundred a year by his brush as an artist, designing most artistic and brightly colored picture "posters" for advertisement boards.

Miscellaneous Notes and Receipts.

To Keep Violets Fresh.—If one desires to use violets for the toilet, the following way of keeping them fresh has been found excellent: Surround the stems with wadding, after dipping them in salt water, and cover with a layer of tinfoil. If they are used for interior decoration, place the stems in salt water and besprinkle the flowers. At night cover them firmly with tissue paper and see to it that they are not kept in too warm a place. In this manner they can be kept fresh for several days.

In order to prevent the yellowing of the coatings in water closets, stables, etc., where the exhalations are so strong that the paint turns yellow in twenty-four hours, no white lead paint should be employed, says the Deutsche Malerzeitung. Use only zinc white with a suitable mixing color, thinned with turpentine and water. It is true zinc white is also attacked by strong exhalations, but not in such a degree as white lead, which even under wood-color becomes black and spotted in a short time.

The Faerben Zeitung gives the following receipts:

Polish Varnish.—Mastic, 120 grammes; wood spirit, 1 liter; oil of turpentine, 250 grammes; linseed oil, 200 grammes. Stand away for a few days, shaking frequently, then filter off.

Excellent Polish.—Pale colophony, 1 part; larch turpentine (Venetian turpentine), 3 parts; bleached shellac, 15 parts; alcohol (95 per cent), 40 parts. Allow to stand for three to four weeks in a warm place, shaking frequently before filtering.

Picture Varnish.—Mastic, 350 grammes; Venetian turpentine, 75 grammes; camphor, 15 grammes; oil of turpentine, 1·5 liters.

Mining in Japan.—Regarding gold, silver, copper, and coal mining in Japan, the Zeitschrift für praktische Geologie furnishes the latest statistics. The development of the mining industries in Japan, since the termination of the last war, has been a rapid one, and that country now furnishes considerable quantities of precious and useful metals, although little is heard abroad of this production.

The gold production since 1893 has risen almost 5,000 ounces, and in 1896 reached the yield of 28,300 ounces. The nineteen existing gold mines are partly in the emperor's possession, partly in that of private parties. The most important are those of Sado and Ikuno. Latterly gold has been discovered near Nikko, and the gold production will therefore rise considerably more in the near future. Nikko bids fair to become the center of the Japanese production of precious metals, since besides gold, strongly argentiferous lead ores have been found. By virtue of the Japanese laws, foreigners are permitted to participate in mining undertakings.

Silver is found in forty-five places in Japan, and in 1896 afforded a yield of 1,500,000 ounces, which is equal to an increase of almost 650,000 ounces since 1893.

Very considerable is the copper production of Japan, there being at present seventy mines. During the fiscal year ending June 30 last, 35,000,000 catties, or about 500,000 centners, of copper, valued at 5,800,000 yen (about $3,000,000), were mined. Since 1875 the copper production has increased almost ninefold. Most copper is sent to Hong-Kong, then to China and to England, the total export amounting to 350,000 centners, i. e., five-sevenths of the whole production.

Coal mining has, since the war, risen about 1,500,000 tons, and in 1897 more than 2,000,000 tons of coal, valued at about $6,000,000, were exported. The companies carrying on coal mining are in a very good financial condition. Altogether there are one hundred and twenty coal mines, of which, however, only about fifty are of importance. The most productive is the Miike mine, in the province of Chikugo, yielding 600,000 tons per annum. A new coal field was discovered in 1896, and work has now been commenced on it. It is situated in the province of Iburi, on the river Mukawagawa, and is said to contain 40,000,000 tons above, and 30,000,000 tons below, the level of the sea. Aside from this last discovery, however, it has been computed that the coal stores of Japan, at the present rate of production, will be exhausted in forty-five years.

Heroic Deed of an Engineer.

William Carney, an engineer at the Richmond Rolling Mills, Richmond, Ind., met his death on December 10 by falling against a large gear wheel, which tore off one of his legs. He was alone in the engine room and knew that possibly no one would enter it for hours. Realizing that disaster would result if the fire under the boilers were left burning, he dragged his mutilated body 50 feet to the boiler room, turned off the natural gas which was used as fuel, and then lapsed into unconsciousness. Twenty minutes later the machinery stopped, caused by a lack of steam, and the employes rushed to the engine room to ascertain the reason and found the brave engineer dying.

"WAIT A WHILE," a railroad station in New South Wales, has just won a fight to retain its name, which the railroad company wished to change.

Correspondence.

The Skyscraper and Old Fogyism.

To the Editor of the SCIENTIFIC AMERICAN:

A fire lately occurred on Broadway involving an old style low building and a modern fireproof skyscraper. The fire department, on account of a high wind, was unable to control the fire in the low building, and because some inspectors were delinquent in their duties in not having the skyscraper provided with fireproof window shutters, the latter caught and burned out the interior of its upper stories. The fire chief did the best he could with his Lilliputian apparatus; his little steam squirt guns on wheels puffed and snorted; his Siamesed pipe stem of a perambulating water tower could not be lengthened seventeen stories high, and so he called more funny little squirters and towers to his aid. But, "all the chief's horses and all the chief's men" could not effectively squirt higher than nine stories. The chief saw the ridiculousness of his puny efforts, for he is quoted as saying, "Let her burn, boys." An extended conflagration might have ensued as far as the department was concerned, had not the high fireproof structure stood like a mighty bulwark and firewall to protect what was beyond.

Old method "authorities" now tell us a law should be passed prohibiting buildings being built over a certain limited height in New York, all because the fire department's apparatus has not kept step with the changed modern building construction. A little later some more "authorities" from Philadelphia came to view the ruins, and they also evoked a new law limiting building heights, and imply as well that modern progress must be jerked back to the limits of their old fire-fighting apparatus. They do not even concede that fire-extinguishing methods can be made to conform to the changed building construction.

The whole thing is a farce worthy of being treated by a Cervantes or a Dean Swift.

All experienced traveling men know that a fast express train is safer than traveling on an accommodation or a freight train, and, for much the same reasons, a skyscraper is safer on account of the great skill and the best material used in construction.

Who ever heard of the necessity of shoring up one of these buildings to keep it from tumbling down, like the low, flat Rothschild building in Brooklyn?

Instead of laws limiting the height of building, called for by the New York and Philadelphia fire chiefs, we should require laws compelling the building of nothing but skyscrapers along the blocks facing Broadway in place of the low buildings that are the true sources of conflagration. Who ever heard of a serious fire originating in a skyscraper? Two parallel blocks of rows of skyscrapers from the Battery to the Harlem River would prove an efficient fire wall, extending along the backbone of Manhattan Island, to prevent an extended conflagration in a high wind, such as devastated Chicago before they were built in that city. The more twenty-story buildings, the better.

The next problem to be solved is to make each skyscraper its own stationary water tower for its individual purposes, and also to drown out fires in surrounding buildings, even those across the street, and to water soak any insignificant tinder box structure that may be on fire below.

Then construct permanent stationary means to conduct plenty of water to each building, independent of the present overtaxed water system, and then provide means to get the water to the place needed with sufficient force.

The tall buildings of Western cities are provided with two or more stand pipes reaching through to their roofs, to which two or more engines may be attached to each pipe when necessary and the water pumped in solid, unbroken streams unaffected by prevailing winds to any desired heights; and in certain sections of these cities hose carts do not accompany an engine. Other cities, like Detroit, have laid underground conduits from the river independent of the usual water supply system, and a powerful fire boat forces the water to the desired locality, and may be operated if desired in conjunction with the stationary stand pipe, with or without the assistance of the usual fire engine. Few of our buildings are provided with accessible stand pipes, and we are unable to avail ourselves of the admirable river fire boats for inland purposes; our only auxiliary to the toy fire engines is a water tank on the roof, that seldom, if ever, is full or holds enough water or gives adequate pressure where and when most needed; or a pumping apparatus in the basement that is of little use, on account of the time to get it in operation, or is of sufficient capacity. Both of these aids practice has shown are quite impractical and unreliable.

There is probably no city in the world so admirably situated as New York for adequate fire service to meet modern requirements. For, situated on a long, narrow island completely surrounded by water, and salt water at that, we have ideal conditions for an ideal installation. We may even banish hose carts, water towers, and engines on wheels and stop killing our citizens and the firemen (who are often strapped to their seats) in their mad career through our streets, sell our engine houses and take our firemen to fires in comfortable patrol wagons unaccompanied by the deadly jaggernauts of dangerous fire apparatus.

This may be done by building underground parallel pipe lines at convenient distances apart from both the East and North Rivers toward Broadway, with suitably situated and accessible valves to prevent undesired intercommunication.

These pipe lines could be connected to commodious stand pipes in each building, and each floor provided with hose, and each fourth floor provided with pipes branching toward the exposed sides of each building from the stand pipe, and provided with a dirigible nozzle toward the street or areaways.

The river ends of each pipe would be provided with three to five siamese connections to which the same number of fire boats could be connected. It will then be possible to generate a water pressure that will blow the very skylights out of a fifty-story building; and if five fire boats cannot do it, connect the stand pipe with five other fire boats from the other river.

A fire on any floor of a building thus protected may be fought from within by half a dozen streams of salt water and from without with as many more from adjoining buildings, especially from across the street; and if any tiny steam fire engine wheezes its protests, it could by these means be washed into the bay.

Our present fire system is, from recent examples, too glaringly inadequate and out of date, and even though my suggestions are adopted finally by the city, it will take our municipal fathers and heads of departments so long to get their commissions agreeably adjusted, that I would seriously advise the owners of our skyscrapers to place no further reliance on the senile fire department, or await the tardy action of the commissioners in the matter, but take immediate steps to install the electric pump system as outlined for emergency purposes, and thus be independent of municipal incapacity and procrastination. The chief points in its favor are the quickness, facility, and cheapness of the installation and operation. It requires no skilled attendance other than the intelligence of turning a switch lever or a rheostat handle, and requires no addition to the present building employes. No steam boilers or additional machinery will be required. In fact, the system will be independent in all respects of existing apparatus, with practically no expense after installation, except interest on cost price and for electric current in case of fire, and possibly no appreciable extra piping, as the pumps could be connected directly to the existing water supply pipes.

JEAN A. WETMORE.

Brooklyn, N. Y., December 10, 1898.

Oil as a Road Material.

To the Editor of the SCIENTIFIC AMERICAN:

The great interest that is now being awakened in all parts of our country in the Good Roads movement is born of necessity. In the keen competition in all the markets of the world, America is at a disadvantage, commercially, by reason of bad roads, much as the railroads have done to bring the producer and the consumer close together. The best investigations yet made on the subject show that it costs on an average 25 cents per ton mile to market the produce of our farms over the country roads, often much more; or, the farmers spend as much for one mile as the railroads ask for 75 miles of haulage.

Great areas of our prairie farm country are remote from any supply of good road material, and the outlook for good roads in these sections is discouraging on account of the expense. Some cheap substitute for stone, brick or gravel, if it could be found, is most desirable.

I venture to suggest to your readers that possibly cheap oil may be one solution, and offer this paper in order to induce others to multiply the experiments I am now making. On a certain clay road in Pennsylvania, which lay deep in dust in summer and deep in mud in winter and spring, there was an oil pipe line by the side of the road, which on a certain occasion sprung aleak and spurted a considerable quantity of oil onto the road. An observer noted that for a space of several rods, to which the oil was transported by horses' feet and wagon wheels, this road showed a marked improvement. The dust in summer did not rise, the mud in spring and winter did not exist. The explanation would seem to be that the oil formed a water-tight covering to the road, and the earth beneath being dry no ruts or mud could form and the road became good.

At the recent Good Roads Convention in St. Louis, Mo., the writer brought forward this idea and offered it as a possible help to improving our dirt roads at a small cost, occasioning considerable comment. It seemed rational and at least easy to try, and many asked questions not easy to answer, for want of sufficient knowledge as to method of applying the oil, the best kind of oil to use, the quantity to put on the road, etc.

As confirmatory of the value of oil on roads, the following observations were made: A gentleman from California said that near Santa Barbara, where he lives, they have oil wells and have used the oily sand from the borings to fill holes and ruts in the road, and in places the sand has even been distributed over the roadway. In all these places the road is free from dust in the dry season (a great curse out there), and perfectly hard and firm in the wet season; and he now thinks it must be due to the oil in the sand. Another gentleman said he used to handle oil at Austin, Texas, in years gone by; he remembered the lot, of perhaps a quarter acre, where he had his depot became sprinkled with oil from leaky cans, and was always hard and firm despite the weather, and he thought it must have been the oil that did it. Another, a road builder from Missouri, said that on a muddy road leading into his town a man let a barrel of black oil fall from his wagon, breaking it and spilling the contents. Ever since then he had noticed there was a firm piece of road near that place, where it did not get muddy or rut, and he thought same was due to the oil. A railroad man said the Pennsylvania Railroad began spraying their roadbed with oil to lay the dust, and now found it not only laid the dust, but shed water, kept down the weeds, and preserved the ties.

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A second part of the roadway was sprinkled more lightly about 300 feet further, making 500 or 600 feet in all, and used eight barrels of oil in the experiment. The day after the sprinkling was done and before the oil had time to become absorbed, for it soaked in very slowly, a heavy rain fell. The road was examined during the rain, and quite a marked difference was seen between the oiled and unoiled portions. Where oiled it was evident that the dirt beneath the surface was still dry and retained its supporting power, while on each side of the oiled portion it was muddy and rutty. A heavy freeze, with the temperature at zero, followed the rain, and on the 25th the road was again examined. The oiled part was still more different from the neighboring stretches; the unoiled road was cut up with ruts one to two inches deep, and frozen rough and hard; the oiled portion was perfectly smooth, and the wheels made on it a muffled sound that showed the dirt beneath the surface was unfrozen and dry.

It will scarcely be possible until the spring thaw comes to really estimate the value of the oil, but at present the experiments seem to promise well. It is too soon to make any good estimate of the quantity of oil required per mile of road. It will possibly vary with the character of the soil, whether loam, sandy, clay or gumbo. The place selected for this experiment is a regular black gumbo, which cuts normally into ruts hub-deep, and holds the water like a jug.

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1. The road should be smoothly graded and rounded well, so as to shed water.

2. Apply the oil to the roadbed while dry. If the soil is filled with water, the oil will penetrate with difficulty, and much of it will be carried off on the wheels of passing wagons.

3. It would be well to roll the ground after the oil is put on. It has a tendency to collect in ruts and small hollows, and the roller would force it into the soil and distribute it evenly.

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M. MEIGS, U. S. C. E.

U. S. Engineer Office, Keokuk, Ia., November 30, 1898.

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including the Broadway line, is eventually to be furnished from one great central station at Ninety-sixth Street and the East River. It will have a capacity of 70,000 horsepower, or over four times that of any existing power station in this country. The plant will consist of 87 water-tube boilers of 800 horsepower each; 11 cross compound engines, each of 6,600 horsepower; and 11 direct connected three-phase alternating current generators. The current, at 6,000 volts, will be led to 8 substations, conveniently located with reference to the various lines. Here it will be converted by static and rotary converters to a pressure of 550 volts, at which it will pass to the conductors.

Military Firearms.

The military attachés of the United States army abroad report, says The New York Post, that a number of foreign countries have decided in favor of the adoption of the Spanish Mauser rifle, as a result of the showing made in the Spanish-American war. According to the information received, the following countries will use the Mauser rifle exclusively: Turkey, Argentine Republic, Chile, Mexico, Sweden, and Brazil. The only country to take up the Krag-Jorgensen rifles is Norway. Several of the first named countries were ordering a limited number of the Mauser rifles before last summer, but the decision to adopt this arm exclusively has, in a number of cases, been only lately reached. Brazil, Chile, and Mexico will employ the caliber of 0·276-inch; Turkey and the Argentine Republic have decided upon the caliber 0·301-inch. Sweden will use a caliber of 0·256-inch. The Krag-Jorgensen adopted by Norway will have a caliber of 0·256 inch. The caliber of the United States arm is 0·30-inch.

The Loewe works at Berlin have the orders for the majority of the Spanish Mausers. It was this establishment which first developed the gun, and the Spanish army was partially equipped with weapons made at the German works and partly at the arsenal at Oviedo, Spain. The Spanish Mauser is an improved Belgian Mauser. The gun is essentially a German weapon, the term "Spanish" being applied to the model which was adopted by the Spanish government. The gun is held to be free from objectionable features which characterize most magazine arms and it is considered by military men on the Continent to be the best army weapon in existence.

The militia and volunteers of Canada are now equipped with the Lee-Enfield magazine gun, which is an improvement on the Lee-Metford now in the hands of the British line regiments. The Lee-Enfield has but five grooves and the Lee-Metford seven, and the rifling is sharper and the depth of the grooves is increased from 0·003-inch to 0·005-inch. The alterations in the gun were largely caused by the erosive effect of cordite. One of the new rifles has been fired 13,000 times and still gives good results.

The Chief of the Bureau of Ordnance of the Navy Department, Captain Charles O'Neil, is making every effort to secure a common caliber for the guns of the army and navy of the United States, and he is backed in the matter by many ordnance experts. The present navy gun has a caliber of 0·236-inch. While the weapon gives splendid ballistic results, it is not a favorite for rough service. The necessity for a common caliber gun is almost too evident for discussion. Thus, while the vessels of Rear Admiral Dewey may have their magazines filled with cartridges of 0·276 caliber, yet these cartridges are useless to our troops in the Philippines should the latter run short of cartridges. The joint board appointed to consider the subject has just reported favorably, but does not deem an immediate change of vital importance.

Something About the Chinch Bug.

The United States Department of Agriculture has in press and will soon issue Bulletin No. 15, Division of Entomology, entitled "The Chinch Bug." The chinch bug is one of the most destructive insects with which the American farmer has to contend, and the department receives many requests for information about it. This bulletin is intended to meet this demand, and gives many new facts concerning the life history and distribution of the species, and the whole subject of the practical handling of its diseases in order to assist in its destruction is treated at length. It says few insects have caused such pecuniary losses as the chinch bug, and no other insect native to the western hemisphere has spread its devastating hordes over a wider area of the country with more fatal effect to the staple grains of North America. It is widely distributed over the world and hibernates in the adult stage. It is of gregarious habits and migrates in spring, summer and autumn. The bulletin states that it would appear that this pest first made its presence known in this country in North Carolina in 1783, and mentions several serious outbreaks of the bug in the West, the estimated losses from its ravages from 1850 to 1887 reaching $267,000,000. It also says that it is believed that the losses up to 1898 amounted to fully $330,000,000.

Science Notes.

Some interesting experiments on the velocity of sound were recently made by M. Frot, near Bourges. Two sets of experiments gave for the velocity in air at 0° C. mean results of 330·6 and 330·9 meters per second. The times were measured automatically by electric chronographs.

As is well known to botanists, but not so well known to the general public, says Prof. C. E. Bessey in Science, the white powdery coating on some leaves and fruits is waxy in nature and is called "bloom" in technical works on botany. Its function has received some attention, Mr. Darwin having made it the object of some studies in his later years. In a recent number of The Laboratory Bulletin, of Oberlin College, is a short paper by Miss Roberta Reynolds, giving the results of a series of experiments which show that when the bloom is removed from the epidermis the transpiration of water is greatly increased. Thus in case of Agave utahensis the loss was about two and a half times as much from the leaf which was without bloom as from that with the bloom. It was observed, also, that on damp days the difference between the leaves was less than on dry days; so, too, there was less difference in the case of young leaves than when old ones were used.

Medical statistics of the American-Spanish war, as reported by the Surgeon-General of the United States Army, stands as follows: From May to September, inclusive, and representing an army of 167,168 men, there were reported in full 1,715 deaths. Of this number, 640 were due to typhoid fever, 97 to malarial fevers, and 363 to diarrhea and dysentery. The death rates of May and June—0·46 and 0·70—were not in excess of those of the army in peace times; in July the rate reached 2·15 for the month, or 25·80 per 1,000, which does not much exceed that of well-cared-for cities. But in August the rate became excessive, or 4·08 per month, or 48·96 per 1,000 per year. In September the conditions improved and the death rate fell to 2·45, or 29·40 per year. The records of the civil war show that a high death rate in August was generally continued for months after, and Dr. Sternberg ascribes the improvement noted in September to the stricter sanitary measures adopted.

"The fate which he dreaded has already overtaken Luccheni," says The British Medical Journal, November 5. "The criminal anthropologists have naturally marked the murderer of the Empress of Austria for their own as a subject of scientific study. The corpus vile of the criminal will doubtless be reserved for Prof. Lombroso or some expert of equal rank, but in the meantime some eager investigators have been studying photographs of Luccheni. To the eye of the ordinary observer he looks a commonplace ruffian, but the criminal anthropologists, we are assured, at once see even in a photograph complete asymmetry of the body. Amyotrophy of the face, neck, trunk, arm, and leg on the left side is very marked. These stigmata are the consequences of grave cerebrospinal lesions occurring in infancy, and due to heredity, alcoholic atavism, misère physiologique, or some disease of infancy, perhaps an encephalomyelitis or lateral sclerosis, from which complete recovery never took place. Luccheni is pronounced to be a type of the asymmétrique déséquilibré. It would have been more satisfactory if the criminal anthropologists could have recognized all these evidences of criminality before Luccheni had perpetrated the crime which has given him the notoriety of infamy which he coveted."

To speak of a color-blind artist sounds like joking, said a noted London oculist; but strange as it seems, there are several persons so affected who can nevertheless paint extremely well. Numbers of color-blind people there are, of course, who draw perfectly in pencil, ink, and crayons, but I myself know a scene painter attached to a provincial theater who, though "color-blind," paints all its scenery, and has quite a local name, not only for his "interiors" and oak chambers, but even for landscapes. I can tell you also of two London ladies who consulted me for color-blindness who paint really beautiful pictures. One is the daughter of a late famous artist, and was taught painting by her father. She is quite unable to distinguish red from green, but her colors are labeled with the names, and she has been taught which to use for certain effects. Possibly her painting may seem to her eyes, as it were, drawing with a brush and "shading" with the colors. The other is a lady artist of some celebrity, who has for years exhibited annually in London. The public are not aware that she is color-blind. She painted the "Wedding Group" for a certain noble bridegroom a year or two ago, and also several public men's portraits, and one of an eminent physician fetched 500 guineas. There is a gentleman residing at Kensington who, having years ago left the navy through finding his advancement hopelessly barred by his color-blindness, is at present making several hundred a year by his brush as an artist, designing most artistic and brightly colored picture "posters" for advertisement boards.

Miscellaneous Notes and Receipts.

To Keep Violets Fresh.—If one desires to use violets for the toilet, the following way of keeping them fresh has been found excellent: Surround the stems with wadding, after dipping them in salt water, and cover with a layer of tinfoil. If they are used for interior decoration, place the stems in salt water and besprinkle the flowers. At night cover them firmly with tissue paper and see to it that they are not kept in too warm a place. In this manner they can be kept fresh for several days.

In order to prevent the yellowing of the coatings in water closets, stables, etc., where the exhalations are so strong that the paint turns yellow in twenty-four hours, no white lead paint should be employed, says the Deutsche Malerzeitung. Use only zinc white with a suitable mixing color, thinned with turpentine and water. It is true zinc white is also attacked by strong exhalations, but not in such a degree as white lead, which even under wood-color becomes black and spotted in a short time.

The Faerben Zeitung gives the following receipts:

Polish Varnish.—Mastic, 120 grammes; wood spirit, 1 liter; oil of turpentine, 250 grammes; linseed oil, 200 grammes. Stand away for a few days, shaking frequently, then filter off.

Excellent Polish.—Pale colophony, 1 part; larch turpentine (Venetian turpentine), 3 parts; bleached shellac, 15 parts; alcohol (95 per cent), 40 parts. Allow to stand for three to four weeks in a warm place, shaking frequently before filtering.

Picture Varnish.—Mastic, 350 grammes; Venetian turpentine, 75 grammes; camphor, 15 grammes; oil of turpentine, 1·5 liters.

Mining in Japan.—Regarding gold, silver, copper, and coal mining in Japan, the Zeitschrift für praktische Geologie furnishes the latest statistics. The development of the mining industries in Japan, since the termination of the last war, has been a rapid one, and that country now furnishes considerable quantities of precious and useful metals, although little is heard abroad of this production.

The gold production since 1893 has risen almost 5,000 ounces, and in 1896 reached the yield of 28,300 ounces. The nineteen existing gold mines are partly in the emperor's possession, partly in that of private parties. The most important are those of Sado and Ikuno. Latterly gold has been discovered near Nikko, and the gold production will therefore rise considerably more in the near future. Nikko bids fair to become the center of the Japanese production of precious metals, since besides gold, strongly argentiferous lead ores have been found. By virtue of the Japanese laws, foreigners are permitted to participate in mining undertakings.

Silver is found in forty-five places in Japan, and in 1896 afforded a yield of 1,500,000 ounces, which is equal to an increase of almost 650,000 ounces since 1893.

Very considerable is the copper production of Japan, there being at present seventy mines. During the fiscal year ending June 30 last, 35,000,000 catties, or about 500,000 centners, of copper, valued at 5,800,000 yen (about $3,000,000), were mined. Since 1875 the copper production has increased almost ninefold. Most copper is sent to Hong-Kong, then to China and to England, the total export amounting to 350,000 centners, i. e., five-sevenths of the whole production.

Coal mining has, since the war, risen about 1,500,000 tons, and in 1897 more than 2,000,000 tons of coal, valued at about $6,000,000, were exported. The companies carrying on coal mining are in a very good financial condition. Altogether there are one hundred and twenty coal mines, of which, however, only about fifty are of importance. The most productive is the Miike mine, in the province of Chikugo, yielding 600,000 tons per annum. A new coal field was discovered in 1896, and work has now been commenced on it. It is situated in the province of Iburi, on the river Mukawagawa, and is said to contain 40,000,000 tons above, and 30,000,000 tons below, the level of the sea. Aside from this last discovery, however, it has been computed that the coal stores of Japan, at the present rate of production, will be exhausted in forty-five years.

Heroic Deed of an Engineer.

William Carney, an engineer at the Richmond Rolling Mills, Richmond, Ind., met his death on December 10 by falling against a large gear wheel, which tore off one of his legs. He was alone in the engine room and knew that possibly no one would enter it for hours. Realizing that disaster would result if the fire under the boilers were left burning, he dragged his mutilated body 50 feet to the boiler room, turned off the natural gas which was used as fuel, and then lapsed into unconsciousness. Twenty minutes later the machinery stopped, caused by a lack of steam, and the employes rushed to the engine room to ascertain the reason and found the brave engineer dying.

"WAIT A WHILE," a railroad station in New South Wales, has just won a fight to retain its name, which the railroad company wished to change.

Correspondence.

The Skyscraper and Old Fogyism.

To the Editor of the SCIENTIFIC AMERICAN:

A fire lately occurred on Broadway involving an old style low building and a modern fireproof skyscraper. The fire department, on account of a high wind, was unable to control the fire in the low building, and because some inspectors were delinquent in their duties in not having the skyscraper provided with fireproof window shutters, the latter caught and burned out the interior of its upper stories. The fire chief did the best he could with his Lilliputian apparatus; his little steam squirt guns on wheels puffed and snorted; his Siamesed pipe stem of a perambulating water tower could not be lengthened seventeen stories high, and so he called more funny little squirters and towers to his aid. But," all the chief's horses and all the chief's men" could not effectively squirt higher than nine stories. The chief saw the ridiculousness of his puny efforts, for he is quoted as saying, "Let her burn, boys." An extended conflagration might have ensued as far as the department was concerned, had not the high fireproof structure stood like a mighty bulwark and firewall to protect what was beyond.

Old method "authorities" now tell us a law should be passed prohibiting buildings being built over a certain limited height in New York, all because the fire department's apparatus has not kept step with the changed modern building construction. A little later some more "authorities" from Philadelphia came to view the ruins, and they also evoked a new law limiting building heights, and imply as well that modern progress must be jerked back to the limits of their old fire-fighting apparatus. They do not even concede that fire-extinguishing methods can be made to conform to the changed building construction.

The whole thing is a farce worthy of being treated by a Cervantes or a Dean Swift.

All experienced traveling men know that a fast express train is safer than traveling on an accommodation or a freight train, and, for much the same reasons, a skyscraper is safer on account of the great skill and the best material used in construction.

Who ever heard of the necessity of shoring up one of these buildings to keep it from tumbling down, like the low, flat Rothschild building in Brooklyn?

Instead of laws limiting the height of building, called for by the New York and Philadelphia fire chiefs, we should require laws compelling the building of nothing but skyscrapers along the blocks facing Broadway in place of the low buildings that are the true sources of conflagration. Who ever heard of a serious fire originating in a skyscraper? Two parallel blocks of rows of skyscrapers from the Battery to the Harlem River would prove an efficient fire wall, extending along the backbone of Manhattan Island, to prevent an extended conflagration in a high wind, such as devastated Chicago before they were built in that city. The more twenty-story buildings, the better.

The next problem to be solved is to make each skyscraper its own stationary water tower for its individual purposes, and also to drown out fires in surrounding buildings, even those across the street, and to water soak any insignificant tinder box structure that may be on fire below.

Then construct permanent stationary means to conduct plenty of water to each building, independent of the present overtaxed water system, and then provide means to get the water to the place needed with sufficient force.

The tall buildings of Western cities are provided with two or more stand pipes reaching through to their roofs, to which two or more engines may be attached to each pipe when necessary and the water pumped in solid, unbroken streams unaffected by prevailing winds to any desired heights; and in certain sections of these cities hose carts do not accompany an engine. Other cities, like Detroit, have laid underground conduits from the river independent of the usual water supply system, and a powerful fire boat forces the water to the desired locality, and may be operated if desired in conjunction with the stationary stand pipe, with or without the assistance of the usual fire engine. Few of our buildings are provided with accessible stand pipes, and we are unable to avail ourselves of the admirable river fire boats for inland purposes; our only auxiliary to the toy fire engines is a water tank on the roof, that seldom, if ever, is full or holds enough water or gives adequate pressure where and when most needed; or a pumping apparatus in the basement that is of little use, on account of the time to get it in operation, or is of sufficient capacity. Both of these aids practice has shown are quite impractical and unreliable.

There is probably no city in the world so admirably situated as New York for adequate fire service to meet modern requirements. For, situated on a long, narrow island completely surrounded by water, and salt water at that, we have ideal conditions for an ideal installation. We may even banish hose carts, water towers, and engines on wheels and stop killing our citizens and the firemen (who are often strapped to their seats) in their mad career through our streets, sell our engine houses and take our firemen to fires in comfortable patrol wagons unaccompanied by the deadly juggernauts of dangerous fire apparatus.

This may be done by building underground parallel pipe lines at convenient distances apart from both the East and North Rivers toward Broadway, with suitably situated and accessible valves to prevent undesired intercommunication.

These pipe lines could be connected to commodious stand pipes in each building, and each floor provided with hose, and each fourth floor provided with pipes branching toward the exposed sides of each building from the stand pipe, and provided with a dirigible nozzle toward the street or areaways.

The river ends of each pipe would be provided with three to five siamese connections to which the same number of fire boats could be connected. It will then be possible to generate a water pressure that will blow the very skylights out of a fifty-story building; and if five fire boats cannot do it, connect the stand pipe with five other fire boats from the other river.

A fire on any floor of a building thus protected may be fought from within by half a dozen streams of salt water and from without with as many more from adjoining buildings, especially from across the street; and if any tiny steam fire engine wheezes its protests, it could by these means be washed into the bay.

Our present fire system is, from recent examples, too glaringly inadequate and out of date, and even though my suggestions are adopted finally by the city, it will take our municipal fathers and heads of departments so long to get their commissions agreeably adjusted, that I would seriously advise the owners of our skyscrapers to place no further reliance on the senile fire department, or await the tardy action of the commissioners in the matter, but take immediate steps to install the electric pump system as outlined for emergency purposes, and thus be independent of municipal incapacity and procrastination. The chief points in its favor are the quickness, facility, and cheapness of the installation and operation. It requires no skilled attendance other than the intelligence of turning a switch lever or a rheostat handle, and requires no addition to the present building employes. No steam boilers or additional machinery will be required. In fact, the system will be independent in all respects of existing apparatus, with practically no expense after installation, except interest on cost price and for electric current in case of fire, and possibly no appreciable extra piping, as the pumps could be connected directly to the existing water supply pipes.

JEAN A. WETMORE.

Brooklyn, N. Y., December 10, 1898.

Oil as a Road Material.

To the Editor of the SCIENTIFIC AMERICAN:

The great interest that is now being awakened in all parts of our country in the Good Roads movement is born of necessity. In the keen competition in all the markets of the world, America is at a disadvantage, commercially, by reason of bad roads, much as the railroads have done to bring the producer and the consumer close together. The best investigations yet made on the subject show that it costs on an average 25 cents per ton mile to market the produce of our farms over the country roads, often much more; or, the farmers spend as much for one mile as the railroads ask for 75 miles of haulage.

Great areas of our prairie farm country are remote from any supply of good road material, and the outlook for good roads in these sections is discouraging on account of the expense. Some cheap substitute for stone, brick or gravel, if it could be found, is most desirable.

I venture to suggest to your readers that possibly cheap oil may be one solution, and offer this paper in order to induce others to multiply the experiments I am now making. On a certain clay road in Pennsylvania, which lay deep in dust in summer and deep in mud in winter and spring, there was an oil pipe line by the side of the road, which on a certain occasion sprung aleak and spurted a considerable quantity of oil onto the road. An observer noted that for a space of several rods, to which the oil was transported by horses' feet and wagon wheels, this road showed a marked improvement. The dust in summer did not rise, the mud in spring and winter did not exist. The explanation would seem to be that the oil formed a water-tight covering to the road, and the earth beneath being dry no ruts or mud could form and the road became good.

At the recent Good Roads Convention in St. Louis, Mo., the writer brought forward this idea and offered it as a possible help to improving our dirt roads at a small cost, occasioning considerable comment. It seemed rational and at least easy to try, and many asked questions not easy to answer, for want of sufficient knowledge as to method of applying the oil, the best kind of oil to use, the quantity to put on the road, etc.

As confirmatory of the value of oil on roads, the following observations were made: A gentleman from California said that near Santa Barbara, where he lives, they have oil wells and have used the oily sand from the borings to fill holes and ruts in the road, and in places the sand has even been distributed over the roadway. In all these places the road is free from dust in the dry season (a great curse out there), and perfectly hard and firm in the wet season; and he now thinks it must be due to the oil in the sand. Another gentleman said he used to handle oil at Austin, Texas, in years gone by; he remembered the lot, of perhaps a quarter acre, where he had his depot became sprinkled with oil from leaky cans, and was always hard and firm despite the weather, and he thought it must have been the oil that did it. Another, a road builder from Missouri, said that on a muddy road leading into his town a man let a barrel of black oil fall from his wagon, breaking it and spilling the contents. Ever since then he had noticed there was a firm piece of road near that place, where it did not get muddy or rut, and he thought same was due to the oil. A railroad man said the Pennsylvania Railroad began spraying their roadbed with oil to lay the dust, and now found it not only laid the dust, but shed water, kept down the weeds, and preserved the ties.

The present experiments are being made through the liberality of the Standard Oil Company, who, by Mr. Rockefeller's orders, placed a tank of crude oil at the disposal of the writer. On November 20, the writer coated a newly graded piece of dirt road with oil, distributed by means of an improvised sprinkler, over a strip about 12 feet wide by 200 feet long.

A second part of the roadway was sprinkled more lightly about 300 feet further, making 500 or 600 feet in all, and used eight barrels of oil in the experiment. The day after the sprinkling was done and before the oil had time to become absorbed, for it soaked in very slowly, a heavy rain fell. The road was examined during the rain, and quite a marked difference was seen between the oiled and unoiled portions. Where oiled it was evident that the dirt beneath the surface was still dry and retained its supporting power, while on each side of the oiled portion it was muddy and rutty. A heavy freeze, with the temperature at zero, followed the rain, and on the 25th the road was again examined. The oiled part was still more different from the neighboring stretches; the unoiled road was cut up with ruts one to two inches deep, and frozen rough and hard; the oiled portion was perfectly smooth, and the wheels made on it a muffled sound that showed the dirt beneath the surface was unfrozen and dry.

It will scarcely be possible until the spring thaw comes to really estimate the value of the oil, but at present the experiments seem to promise well. It is too soon to make any good estimate of the quantity of oil required per mile of road. It will possibly vary with the character of the soil, whether loam, sandy, clay or gumbo. The place selected for this experiment is a regular black gumbo, which cuts normally into ruts hub-deep, and holds the water like a jug.

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2. Apply the oil to the roadbed while dry. If the soil is filled with water, the oil will penetrate with difficulty, and much of it will be carried off on the wheels of passing wagons.

3. It would be well to roll the ground after the oil is put on. It has a tendency to collect in ruts and small hollows, and the roller would force it into the soil and distribute it evenly.

4. Crude oil costs from 60 to 90 cents per barrel at the wells. Its odor is disagreeable, and oil from which the naphtha and kerosene has been extracted would be preferable to apply in warm weather. When cold the heavy oil becomes too stiff to be applied without heating. This could be overcome by some form of spraying apparatus, using a jet of steam.

M. MEIGS, U. S. C. E.

U. S. Engineer Office, Keokuk, Ia., November 30, 1898.

A Word to Our Subscribers.

We wish to remind our many readers that with this issue many subscriptions will expire, and, in order to prevent any break in the receipt of the paper, it is advisable to remit for the new year with as little delay as possible. We feel that the SCIENTIFIC AMERICAN has been better during the year 1898 than ever before, and we trust our readers will appreciate this fact by sending in their subscriptions promptly and by inducing their friends to subscribe. Many of our readers who are not receiving the SUPPLEMENT would also find that they would obtain enough valuable information in the course of three months to pay for the year's subscription, and by subscribing to both papers at the combined rate, a substantial reduction can be secured. Our Building Edition should not be forgotten.

COLLAPSE OF A LARGE GAS HOLDER.

In the accompanying illustrations are shown the extraordinary ruins of a large gas holder which collapsed during its trial test on the afternoon of Tuesday, December 13. The wrecked structure had recently been built for the Consolidated Gas Company, of New York, on a portion of their property lying between First Avenue, Avenue A, Twentieth and Twenty-first Streets.

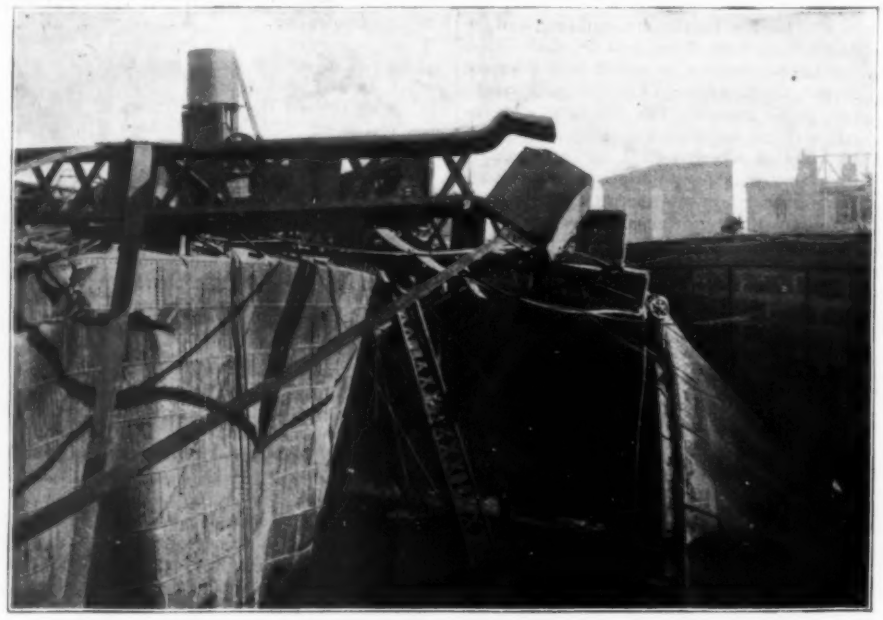
In order to understand the nature of the disaster and explain the complicated appearance of the wreckage, it will be well to explain briefly the method of constructing a large modern telescopic gas holder of this type. As the object of these structures is to serve as reservoirs in which to store up the gas as it passes over from the retorts and purifiers, and before it is drawn off into the city mains, it is evident that they must be capable of enlarging or reducing their capacity to match the greater or smaller surplus of gas at the works. If a variable storage capacity were not provided in the reservoirs, it would be necessary to compress the gas in heavy steel reservoirs—obviously too costly a method.

The system adopted is to use an inverted cylindrical holder closed at one end and with the open end resting in a tank of water. The gas is introduced by pipes which pass up through the water of the tank into the inverted gas holder. As the gas flows in it lifts the gas holder, and as it is drawn off into the mains the holder descends. To keep the holder in the vertical position and cause it to telescope concentrically within the water tank, it is provided around its upper edge with a series of guide wheels, which travel against guide rails carried on a series of braced vertical columns that surround the tank. The arrangement will be understood by referring to the gas holders shown in our cuts as adjoining the wrecked structure.

In the earlier gas holders it was customary to place the water tank in an excavation, with the surface of the water at the ground level; but for reasons of economy it is now customary to place only about one-half the depth of the tank below ground. Moreover, in many locations where there is tide or river water in the vicinity, the work of excavation might be exceedingly troublesome.

When the gas works are located in the heart of a city, the great cost of the land makes it desirable to keep down the diameter of the gas holder and secure the necessary capacity by giving it additional height. As it is impossible, because of the cost, to greatly increase the depth of the tank, the inverted gas holder is made in sections, which telescope within each other, the topmost section being closed and those below it consisting of open-ended cylinders. When a gas holder of this kind is empty, the sections all rest on the bottom of the tank, the closed section being the innermost of the series. As the gas enters the inner and closed section it lifts it until the latter is clear of the tank, when it catches hold of the next section and pulls it up with it. This is repeated until the series is extended to its full height. The sections lift each other by means of rectangular troughs formed at their lower and upper edges, the trough around the upper edge of one section lapping over and down into the trough of the section above it. The troughs are filled with water, which forms a seal to prevent the escape of the gas.

The wrecked structure was of the telescopic kind, and the holder was built in four sections. The water tank, which was built of mild steel, was 42 feet deep and 178 feet in diameter. About one-half of it was built in the ground and some 35 feet of it projected above the ground level. When the holder was extended to its full height, it stood over 160 feet above the ground. The capacity of the tank was about 3,500,000 cubic feet of gas, and it was one of the largest in the country, being exceeded by three others: One owned by the East River Gas Company in Long Island City, of 5,000,000 cubic feet, one owned by the Mutual Company in East Twelfth Street, of 4,000,000 cubic feet, and another 4,000,000 cubic feet holder in Chicago. The largest in the world is in London; it holds 12,000,000 cubic feet, while there are two others of 6,000,000 cubic feet in London, and one of like size in Birmingham, England.

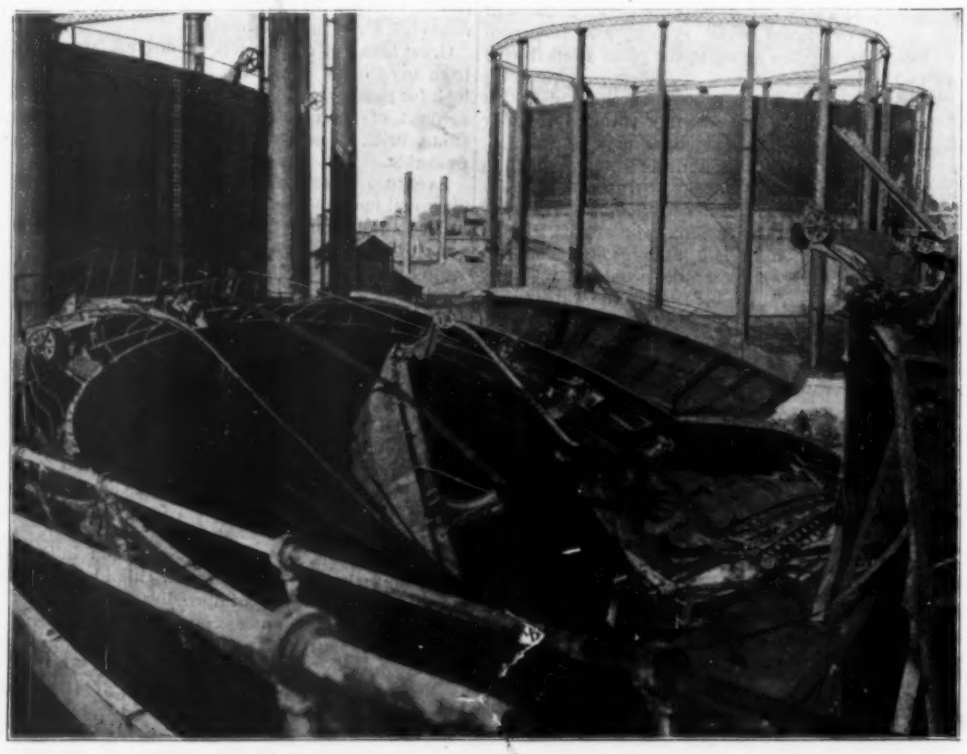


1.—TOPMOST SECTION OF HOLDER, WITH PORTION OF FRAME FALLEN ACROSS IT.

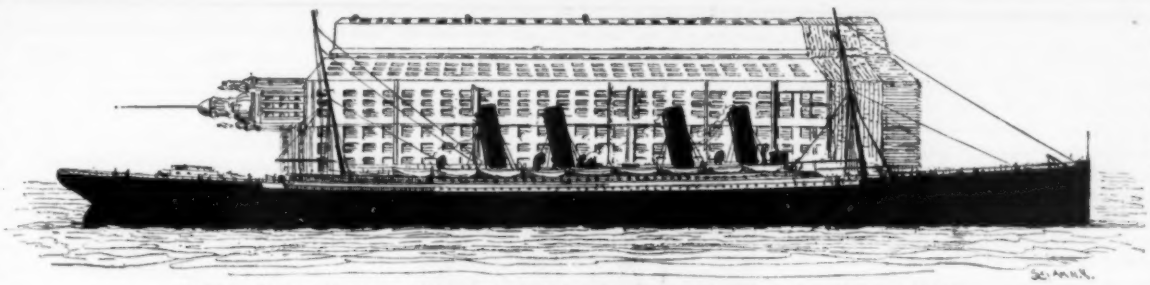
2.—WRECKAGE OF THE FRAME LYING ACROSS TWENTY-FIRST STREET.

The structure was being tested by filling it with air, when, at 5:30 in the evening, the wall of the tank on the north, or Twenty-first Street side, split open from top to bottom. The water rushed out in enormous volume, filling Twenty-first Street to a depth of several feet and flooding the neighborhood for several blocks around. The wall of the tank being split, it fell outward under the pressure, knocking away the posts of the guide frame, which fell in a tangled mass across the holder, the ruins of the frame reaching clear across Twenty-first Street and falling upon the holders in the adjoining lot (see Fig. 2). It is probable the fall of the guide frame was preceded by the dropping or telescoping of the holder, the various sections or lifts of which can be seen lying within one another in Figs. 1 and 3. The rush of water carried away the inclosing wall of the gas company's property, and eyewitnesses describe the "blast" as having been responsible for the wrecking of several buildings in the vicinity.

At the present writing the cause of the disaster is a profound mystery. The design of the structure was of a standard and well approved type, and as far as can be judged the material was of good quality. Some of the phenomena of the wreck, such as the blowing of material to a considerable distance, point to the possibility of gas having entered the holder with the air and formed an explosive mixture. The result of the investigation which is now being carried on will be looked for with considerable interest.

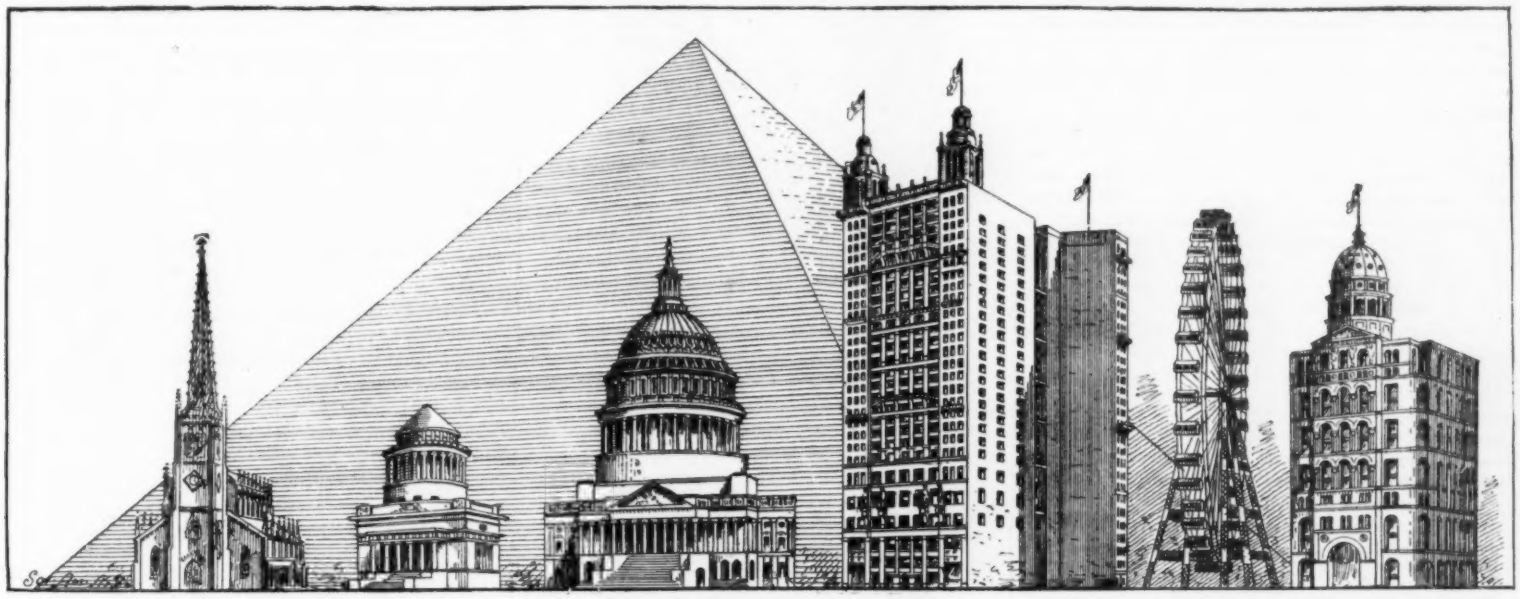


3.—LOOKING DOWN UPON THE WRECK OF THE TANK AND THREE LOWER SECTIONS OF THE HOLDER.



PARK ROW BUILDING COMPARED WITH THE "KAISER WILHELM DER GROSSE."

Park Row Building: Distance from bottom of piles to top of flagpole, 501 feet; weight, 20,000 tons.
"Kaiser Wilhelm": Extreme length on deck, 649 feet; weight, 20,000 tons.



Trinity Church, New York. 288 feet. | Grant's Tomb, New York. | Dome of Capitol, Washington. 287½ feet. | Park Row Building, New York. 390 feet. | The Paris Wheel. 305 feet. | World Building, New York. 294 feet.

NOTABLE BUILDINGS COMPARED WITH THE GREAT PYRAMID OF EGYPT—HEIGHT, 450 FEET; BASE, 746 FEET.

THE TALLEST OF MODERN OFFICE BUILDINGS.

Although New York city did not undertake the construction of lofty office buildings until they had become a familiar feature in the architecture of some Western cities, it has run them up in such numbers and to such unprecedented heights in the last ten years that they have now become the most characteristic and obtrusive feature of its architecture. The sky line of New York to-day is so changed from that of twoscore years ago that a former resident, returning from abroad after an absence of twenty years, would be quite unable to recognize the city as he steamed up the waters of the bay. The sky line of former years was determined by the uniform level of the five-story buildings which composed the bulk of the down-town districts, broken by such familiar landmarks as the spires of Trinity Church and St. Paul's Chapel, one or two shot towers, and a few church and chapel towers of less conspicuous height. To-day the eye follows a picturesquely irregular line of cornice and roof tops, much of which is over two hundred feet and not a little of it over three hundred feet above the street level.

Towering high above the tallest of these great structures is the vast bulk of the Park Row building, which hits its twin towers 390 feet into mid-air and unfurls its two flags over the city at a height of 447 feet above the sidewalk!

We can imagine that the New Yorker already referred to, on returning to his native city after twenty years of absence, especially if he had lived among the exquisite architecture of the old world, would be tempted at first sight of the Park Row building to exclaim, "What a monstrosity!" And it cannot be denied that their exaggerated vertical proportions render it impossible to judge these buildings by the ordinary canons and pronounce them beautiful. The modern office building, however, is not to be judged by the usual architectural standards. It professes to be nothing more or less than it is—a strictly utilitarian structure, admirably adapted to its purpose of housing the greatest possible number of business men upon a limited area in the city's busiest center. The ever-increasing value of property, the tendency of business to concentrate within certain circumscribed areas, and the possibility opened up by the modern fast-running elevator, have conspired to render necessary and possible the stupendous office buildings of to-day.

Astor House. Erected 1834. | Park Row Building. Erected 1898. | St. Paul Building. Erected 1896. | St. Paul's Chapel Erected 1764.

THE OLD AND THE NEW, AS SEEN FROM ST. PAUL'S CHURCHYARD.

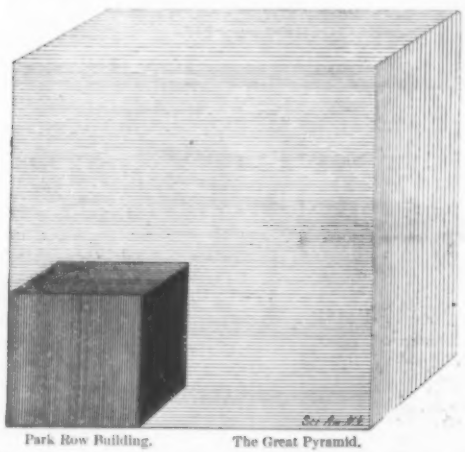
As regards the engineering and architectural problems presented, it must be confessed that the first have been easier of solution than the second. It is a simple matter to pile story upon story and so proportion columns and girders to loads that the structure shall possess eternal stability; but it is an altogether different problem for the architect to clothe the "skeleton" with a mantle of stone and glass that shall appear diversified, yet dignified and appropriate.

It will, we think, be admitted that in his treatment of the towering pile of the Park Row building, the architect, Mr. R. H. Robertson, has produced a very satisfactory effect. The bald, tower-like impression which would naturally be conveyed by a façade nearly 400 feet high on a base of about

100 feet is modified by treating these stories in sets of four or five and accentuating the width of the building by heavy mouldings and projecting balconies. This accentuation of the horizontal as against the perpendicular lines is successful, for, impressive as it is, the building does not really "look" its full height of 447 feet to the top of the flagpole.

It is not our intention in the present article to enter into a detailed description of the constructional features of the building, which do not differ in any important particulars from the standard work put into buildings of this class. We will rather draw attention to what might be called the sensational and spectacular features of this, the most remarkable commercial building ever erected, or, in respect of its height, likely to be erected.

The plan of the building, as will be seen from the engraving, presents much irregularity, due to the cupidity of some of the adjoining property owners, who asked prohibitive prices. It has a frontage of 103 feet 11 inches on Park Row, 23 feet on Ann Street, and 47 feet 10½ inches on Theater Alley. Two of our illustrations were taken from the Ann Street side, another was taken from the western end of St. Paul's Churchyard, while that on the front page was taken from the roof of the Astor House, looking across the junction of Park Row and Broadway. The area of the lot is 15,000 square feet, and the vast bulk that towers above it, weighing, with the maximum loads that can be placed on the twenty-nine floors, some 54,000 tons, stands (it may surprise some of our readers to know) upon a foundation of sand. No such fate as befell the Biblical house that was built, not upon the rock, but upon the sand, will ever overtake this "end of the century" structure, for the duty of carrying the building is intrusted to some four thousand 12-inch piles, which were driven into the sand by the pile-driver until they refused to budge any further. As the average load that is ever likely to come upon the piles is about 7 tons, while their maximum bearing capacity is over 20



Park Row Building. The Great Pyramid.

COMPARATIVE BULK OF PARK ROW BUILDING AND THE GREAT PYRAMID.

tons, it will be seen that even if the rain descends, and the floods come, and the winds blow and beat upon that house, it will not fall. The piles are spaced 16 inches between centers immediately beneath the vertical columns, and the rows of piles will be about 2 feet apart. Moreover, as the piles are cut off below the level of ground water, they are absolutely indestructible. After the piles were cut off, the sand was removed to a depth of one foot below the top of the piles and concrete was rammed in between them and finished off flush with the top of the piles. Above the piles and concrete were laid large granite blocks to form the bases of the brick piers, the piers being finished off with granite capstones upon which was laid a grillage of 12-inch I-beams.

To insure an even distribution of the pressure, huge "distributing girders" were placed between the foundations and the footings of the vertical columns of the building. These girders are from 8 feet to 47 feet long and vary from 4 feet to 8½ feet in depth. The heaviest of these, which is placed beneath the wall on Theater

STATUE FOR FACADE BY J. MASSEY RHIND.

Alley, weighs 52¼ tons. While on the subject of the steel work, it will be of interest to state that the heaviest load borne by any one column is 1,450 tons.

VERTICAL HEIGHT.—The Park Row building is considerably the tallest commercial building in the world. The following table gives the names and heights of those New York office buildings whose highest point is 300 feet or more above the street level.

The sketch on the adjoining page, which is drawn strictly to scale, shows the relative height above ground level of several notable structures in this country compared with that favorite reference-scale for height and bulk—the Great Pyramid of Egypt. It will be seen that while the Park Row building greatly exceeds the

Name.	Number of Stories.	Tower.	Height.
			Feet
Park Row	29	Yes	390
Manhattan Life	18	Yes	348
St. Paul	26	No	313
American Surety	21	No	312
Commercial Cable	20	Yes	304
Gillender	19	Yes	300

World building, the dome of the Capitol at Washington, and the spire of Trinity Church, New York, it requires all of its 57 feet of flagstaff to bring its highest point within 3 feet of the top of the Pyramid. Omitting the Pyramid, however, it is conspicuously the tallest inhabited building in the world, for while the cornice of the American Surety building is 313 feet above the level of the street, the floor of the restaurant at the top of the Park Row building will be 308 feet above the street, while the floor of the topmost offices in the towers (fine, well-lighted rooms 24 feet in diameter) will be 340 feet above the same level. The main part of the building will have twenty-five stories, while the Park Row front will be twenty-seven stories high, the space between the two towers being occupied by a kitchen for use in connection with a restaurant below it, which will occupy the full width of the building. The cornice of this front is 336 feet above the sidewalk, while the top of the cupola on the towers is 390 feet above the same level. The flagpole truck is 57 feet above the cupola, while the feet of the piles are 54 feet below the street level; hence the total height of the building from shoe of piling to truck of flagpole is over 500 feet.

The point of view from which the building shows its

TYPICAL PLAN OF A FLOOR.

vast proportions to best advantage is that from which our front page engraving was made. The adjoining five-story buildings on either side act as an admirable foil to set off the imposing height. By far the most striking effect, however, is that obtained by standing on the opposite side of Ann Street, which is very narrow, and letting the eye range up the full sweep of twenty-nine stories. The Ann Street frontage is only 20 feet, and, looking up from the street, it has for all the world the appearance of some factory chimney of extremely lean proportions.

Our readers will agree with us that the photograph mentioned, taken with the lens looking almost plumb into the heavens, may be reckoned as among the most original curiosities of the art.

VOLUME AND WEIGHT.—Although the

THE FACADE FROM THE ADJOINING SIDEWALK.

THE VERTICAL PERSPECTIVE OF A MODERN SKYSCRAPER.
View taken from Ann Street.

building admits of comparison in respect of height with the Pyramid, when we come to the question of volume and weight our nineteenth century effort sinks into positive insignificance. The Pyramid, in its present mutilated condition, has a base of about 746 feet square and a vertical height of about 450 feet. Its present volume is estimated at about 82,000,000 cubic feet and its weight at 6,316,000 tons. The Park Row building has a volume of 3,906,580 cubic feet and a total dead weight of 20,000 tons, so that the ancient structure has about twenty-one times the volume and over three hundred times the weight of the modern building.

Evidently in respect of the bulk and weight of our buildings we cannot compete with the ancients, and as the Pyramid is no longer a popular form of mausoleum, it is not likely that we shall ever attempt to.

It is a curious fact, which will come as a surprise to many of our readers, that for all its great size and mass this building is no heavier than the latest ocean liner, the "Kaiser Wilhelm der Grosse." The building contains about 8,000 tons of steel and 12,000 tons of other material, chiefly brick and terra cotta, making a total weight for the building of 20,000 tons. The "Kaiser Wilhelm" displaces 20,000 tons of water, and therefore equals the towering "skyscraper" in weight. The extreme length of the liner is 649 feet, measured on deck, so that she exceeds the greatest dimensions of the building by 148 feet. The total cost of the building was $2,400,000, and that of the ship probably a million or even a million and a half more, the greater cost of the ship being due chiefly to the greater power and weight of machinery, of which about 27,000 horse power is in the ship as against 1,000 horse power in the building. Brick and terra cotta, moreover, are cheaper materials than ship frames and plating.

POPULATION.—This extraordinary building, with its modest frontage of 104 feet on Park Row, and of 20 feet and 48 feet on a side street and an alley, will accommodate the floating population of a fair-sized country town. That this is no exaggeration, the following figures will show. There are in the whole building 950 separate offices. As most of these are of generous proportions, a fair estimate of their capacity would be an average of four people to each office. Now, it is reasonable to assume that there will be at any given hour of the day an average of one visitor in the building on business for each person employed. This would make a total number of persons in the building at any period of the day of 8,000. If we assume that on an average five persons would call at each office during the day, for each person employed, we get a total of about 25,000 souls making use of the building in the course of every working day of the year.

HISTORICAL SURROUNDINGS.—In concluding we draw particular attention to the reproduction of a photograph taken from St. Paul's Churchyard. It would be impossible to find in all America a spot where the old and the new are so strangely blended as here. The venerable ecclesiastical building was erected in 1764 and was originally known as Trinity's St. Paul's Chapel. The site selected was a field of wheat opposite the Common, now the City Hall Park. It was opened for service on October 30, 1766, the sermon being preached by Samuel Auchmuty, D.D., "Rector of Trinity Church and Chaplain to the Right Hon. William, Earl of Stirling." The churchyard sloped westward to the Hudson River, whose shoreline was located where Greenwich Street now extends. The steeple of the church was added in 1794. At that time the church was beyond the city limits, and history records that the people "scrupled not to comment with just severity upon the folly of that visionary set of men, the vestry of Trinity Church, who had put so large and ornate a building in a place so remote and sequestered, so difficult of access, and to which the population could never extend."

Could the captious critic but stand to-day and look around in this "place so remote and sequestered"!

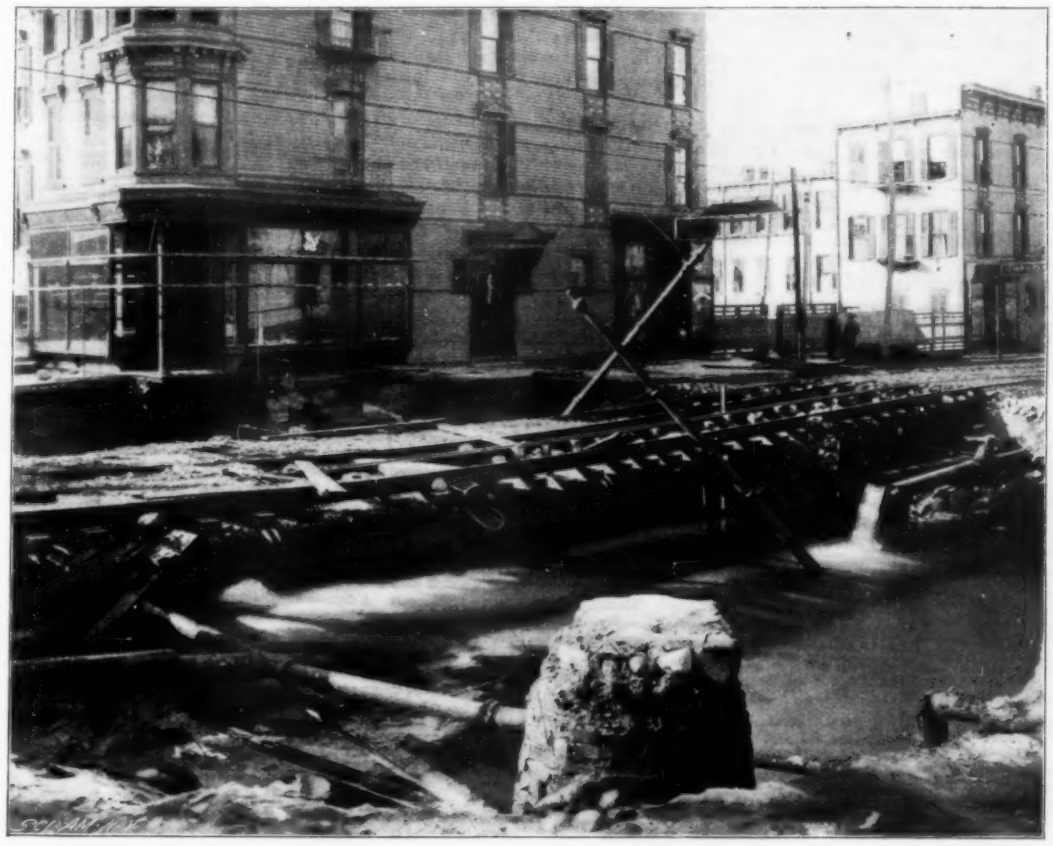
The oldest pew-book extant commenced in 1828 and contains such names as that of Thomas Barclay, the first British consul in the early days of the republic, and other names more or less conspicuous in the history of the city, such as Haight, Larogue, Edward Bacon, Beekman, Stuyvesant, Schuyler, Kip, Lorillard, Goelet, and Stewart. Earlier pewholders in 1787, when the population of New York was only 30,000, were Isaac Jones; Peter Goelet, who lived at 48 Hanover Square; Mayor Richard Varick; Abraham Lawrence; and Mayor James Duane, who lived at 26 Nassau Street (at that time the upper Fifth Avenue of New York.)

On April 30, 1789, immediately after Washington's inauguration, he and both houses of Congress went in procession to St. Paul's and attended appropriate services.

The remains of Montgomery, who fell at Quebec, were, in 1818, deposited beneath the monument erected by Congress to his memory. Other notable monuments are that erected by Edmund Kean in memory of the actor George Frederick Cooke, and that of Bechet, Sieur de Rochefontaine, who served in the revolution. In the burial ground rest not a few other soldiers who fought on one or other side in the revolutionary struggle.

Across the street to the left is seen a portion of the famous Astor House, built in 1834, once the most famous hotel in America, and still a popular resort with those travelers who delight to house themselves amid historical surroundings. The tower-like building across Broadway, 313 feet in height, was the tallest office building in the world until it was overshadowed by its colossal neighbor in the adjoining square.

Our thanks are due to Mr. R. H. Robertson, the architect, and Mr. A. Pauli, who had charge of the erection of the building, for courtesies extended in the preparation of this article.



BREAK IN A 48-INCH WATER MAIN IN BROOKLYN, N. Y.

Gelatine in Gum.

A. Trillat employs commercial formaldehyde solution to render gelatine insoluble, so that it may be detected and the amount present determined, in mixtures containing gum, sugar, or other bodies not precipitated by formaldehyde. The substance to be tested is dissolved in water, and the clear solution evaporated to a sirupy consistence: a little formaldehyde solution is then added and evaporation continued until a pasty consistence is reached. The residue is finally washed by decantation with boiling water, dried, and weighed.—Comptes Rendus, cxxvii., 724.

AN order for 2,500 tons of 83-pound steel rails for an Irish railway has been placed with the Maryland Steel Company. American rails have before this gone to British colonial possessions, but this is understood to be the first time that they have been bought for use in the United Kingdom.

THE BURSTING OF A WATER MAIN IN BROOKLYN.

A 48-inch water main at the corner of Central Avenue and Covert Street, Brooklyn, New York, broke on Sunday, December 11, and did great damage. The pipe was of cast iron and was placed in position about eight years ago. It runs from the Ridgewood reservoir, which is not far distant, to the Prospect Hill pumping station. As a result of the fracture the houses in the neighborhood were undermined and rendered untenantable. For blocks around all the water was cut off and, owing to the break in the supply, a considerable section of Brooklyn was much restricted in the use of water. The gas mains were broken by the caving in of the street and the electric light and the trolley systems were also disorganized. The soil at the point of the break was sandy, which accounts for the fact that the street had been undermined long before the break showed on the surface. As near as could be ascertained it occurred about five o'clock in the morning. The local fire house was notified, and a number of firemen at once ran to the scene of the break to render aid. When they reached the place of the accident, they found the street car tracks on Central Avenue had disappeared and the trolley poles had toppled over, forming a letter A. There was a number of live wires, which made any attempt to render assistance dangerous. In a few moments there was a roaring torrent and the people were fleeing for their lives from adjacent buildings. On the northeast corner there was a four-story tenement house, the ground floor being occupied by a mission chapel. Fortunately, there was no one in the chapel, but the floors above were tenanted, and as it was evident the flood had undermined the building, the police and firemen at once aroused and ordered out all of the occupants. The cellars in the vicinity were flooded to a depth of six feet, and the foreman of the fire engine company informed headquarters that there was danger of a water famine; so that a large part of the chemical apparatus in the city was sent to the fire engine houses in that section. A detail of laborers from the water department at once proceeded to the scene of the accident. It was known at the pumping station that there was already trouble, for the pumps had been drawing nothing but air for an hour. Steam was at once shut off and the water was diverted to other conduits, but for a long time the flood in the Central Avenue main continued to flow, for there was enough water in the huge pipe to still cause trouble. In three hours the flood had assumed the proportions of a spectacle worthy of traveling a long distance to see. At the point of the break the water was surging and boiling like the rapids of a river. The overplus was running over the curbs and sidewalks of the adjacent streets. Vacant lots were submerged and cobble stones, sidewalks, and car tracks were undermined by the flow of the water. During the morning there were a number of narrow escapes, as the sandy soil had been washed away, and a few pedestrians provided with boots, while attempting to ford the street, were almost engulfed, and were rescued with difficulty. Every few minutes the sidewalk would fall in on Central Avenue and the foundations of buildings were carried away. After several hours the water began to recede, and as it went down, the full extent of the damage could be seen. The whole crossing was undermined from one side to the other, making a pit measuring 100 feet in each direction and fully 20 feet deep. As the water fell back it revealed the skeleton of the car tracks and gas and water pipes. Out of one of the 4-inch mains gas was pouring from a fracture, and the odor of the illuminant nearly stifled the crowd at the corner. Finally the gas main was disconnected and all the gas in the neighborhood was cut off. The break in the water pipe was finally discovered. Water was pouring

out in a small stream from it. It was near the bottom of the pipe and was 3 feet long and 12 or 13 inches wide. It was considered by the experts that the break was due to structural weakness in the casting and it was impossible to detect it when the pipe was laid. There was great damage done to the sewer on Central Avenue, which was caved in and which will require several days to rebuild. It is estimated that 4,000,000 gallons of water were wasted before the gates could be closed and the water diverted to other mains.

Canvasing a Ceiling.

The canvasing of a ceiling is a job full of trouble for the inexpert hand, and not altogether a matter of pleasure, says The Master Painter, for anyone else. Different workmen have different ways of doing it. We think, adds the editor, our way as good as any, and better than some. It is not easy to describe the way, however. Then, the character of the job—cheap or otherwise, paint or paper, and so on—must be considered. To begin with, cheap canvas for a cheap job, and good material for a better job. That's the rule; but we would advise a good muslin for even a cheap job, unless you are going to leave the country for good.

One way to canvas is to sew together enough strips to cover the entire ceiling. Then attach one corner of it to one corner of the ceiling, adding a few more tacks along the side selvage, but not driving in the tacks all the way. Now, go to the opposite corner and tack there as you did the first. Then tack all the edge between the two corners. Now you have fastened one end of your canvas. Don't forget to pull as you tack. Beginning again at the first corner, tack along the side, stretching as you go. Then go to the second corner, and tack along that side. Lastly, tack the remaining end.

As to stretching, note that it is not well to get the canvas drum-tight. If overtight, the canvas is liable to wrinkle in time, and nothing should be more dreaded. Should the canvas bag a little, no matter, as it will not be noticed by the casual visitor. In fact, it is impossible to prevent some degree of bagging, no matter how one may try.

For this reason we prefer a one-piece canvas, hanging loose, as it will show but one bag, and that a rather inconspicuous and not ungraceful bag either. Shower-tack it, and you produce the effect of a carriage seat cushion. With blind-seams the same objection obtains. You get not one but several bags, and these by no means sightly ones.

Be sure to secure your edges well with tacks. Use six-ounce tacks. Put in a double row for making it sure. Blind-tacking is done when the canvas has been sewed in one piece, an inch seam being left on each joining, and this strip is "blind-tacked" to the ceiling.

To use single width strips, as in cheaper jobs, using a good strong muslin, take one corner of the strip and tack it in the angle of the wall and ceiling, making thus a little lap over. Drive the tack only enough to hold the material in place. Now go to the other end corner and repeat the same thing there. Next tack the other selvage edge of the strip, taking up the slack, and putting in a few tacks merely to hold in place. Then the strip is in position for the final stretching and tacking. Begin by tacking at the center of the side wall, tacking thence both ways, taking out the first tacks as you go. Pull the muslin as you proceed with the tacking. Tack the other selvage edge as you did the first, only that fewer tacks are needed here, as the next strip comes on top of it, to help secure it. But be sure to draw the material tight. Then tack both ends of the strip, drawing tight and tacking close to the wall.

We now take up the next strip and tack its corner over the first strip, opposite our starting point with the first strip. Then go to the other end and make that fast, temporarily, returning to the first point and tacking all along the edge over edge of the first strip. Don't pull the material too much, but just enough to make it smooth and straight. Temporary tacks will hold it out of your way. Finish as with the first strip, and proceed with the remaining strips until the other side of the room is reached, when you finish up as you began.

Just here remember that you will need a selvage to tack on against the wall, and hence, if your last strip proves to be too wide, split it, and put the cut side on the selvage of the preceding strip, so that you will still have a selvage for the last tacking. Use as strong a muslin as you can afford for a ceiling. Lighter material answers very well for side walls.

In tacking the selvage edge, see that the head of the tack holds down the edge, so that it won't turn up under the paper and cause trouble. Drive in all tacks as far as possible, so that they will be lower, if anything, than the material.

Where the canvas is in one sheet, it may be rolled on a pole, and an assistant can hold this while you tack. The double seam being next to the ceiling, you can tack it to the latter, and no tacks will show on the surface. This is "blind-tacking." The tack is driven in about a quarter inch from the line of sewing. Unroll about a foot more than the single width of strip at a time. Draw your edge taut as you tack.

The muslin or canvas may be sized with glutol paste, over which paper, water, paint, and oil paint will adhere perfectly.

Death of Sir William Jenner.

Sir William Jenner, Physician in Ordinary to the Queen and the Prince of Wales, died December 11, at the age of eighty-three. He is principally noted for distinguished services in the field of clinical medicine. He was the first to establish, beyond dispute, the difference between typhus and typhoid fevers.

The Current Supplement.

The current SUPPLEMENT, No. 1199, contains a number of articles of great interest. "The Gular Pouch of the Great Bustard" is a most curious and interesting ornithological article. "Roman Construction," by G. W. Percy, is continued and is a valuable study. "Dr. William R. Brooks" is a biography of a noted astronomer. As director of the Smith Observatory he has been very successful in comet discovery, having just added the twenty-first to his list. "Calcium" is a paper by Sir Robert Ball, and the number is concluded by a large number of formulas for test papers.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HARROW.—PETER J. HELLER, Montclair, N. J. The harrow of this inventor comprises a toothed frame mounted upon a pair of wheels. An axle connects the wheels and has vertical members formed as tubes open at the top and bottom. Rods slide in the tubes and are attached to the harrow-frame. Springs surrounding the rods between the lower ends of the tubes and the frame, are adapted to hold the frame down. Brace-rods attached to the harrow-frame embrace at their upper ends the vertical rods above the tubes. Lifting-levers mounted upon the axle are attached to the harrow-frame. A depressing-lever having its pivots supported from the harrow-frame, engages the axle, whereby the load upon the axle may be transferred to the harrow-frame when desired.

SCYTHE.—SANFORD J. BAKER and JOHN KING, Oakland, Me. The blade of this scythe is formed with ribs extending over the rear portion of the blade. The ribs diminish in size from the rear to terminate in points. Considerable strength is thus given to the blade, and the danger of the metal's breaking when striking against hard substances is lessened.

PLOW-FENDER.—JOSEPH H. TAYLOR, Lewisport, Ky. This fender comprises a plate provided with an orifice and with a curved slot concentric therewith. Pins held by an arm fastened rigidly to a clamp adapted to be attached to the plow-beam, are passed respectively through the orifice and through the slot. By this means the fender is adjustably held on the arm. A series of slots in the plate permit fine earth to pass through the fender. The fender may be used on any plow and is designed to protect young plants during the tilling of the soil.

Bicycle Appliances.

BRAKE.—LOREN E. CLARK, Shenandoah, Pa. The purpose of this invention is to provide a powerful bicycle-brake which shall have a large effective surface within a comparatively small space. To this end an auxiliary brake-wheel is used, provided with an exterior and interior band-brake. By pressing upon a lever, the exterior band is brought into frictional engagement with the brake-wheel, and the interior band by means of toggle-links is spread into engagement with the inner surface of the wheel.

Engineering Improvements.

ROTARY ENGINE.—JAMES C. WALKER, Waco, Tex. This rotary engine is an improvement upon the mechanism of an engine for which patents were granted to the same inventor. In the present engine, the inlet-port and its cut-off valves are connected with mechanism for operating these valves. The mechanism in question comprises a drive-shaft geared with the engine-shaft; a disk mounted on the drive-shaft to rotate therewith, having a fixed cam to move the inlet-valves in one direction; a ball-governor mounted on the drive-shaft, and a cut-off member mounted on the disk to rotate therewith, but having movement independent thereof. The cut-off member operates to move the valve in a direction reverse to that of a fixed cam on the disk. A rack and pinion mechanism is operated by the shifting of the ball-governor held to engage with and shift the cut-off member.

Mechanical Devices.

COLOR PRINTING-MACHINE.—WILLIAM H. WALDRON, New Brunswick, N. J. In cylinder color printing-machines considerable difficulty has been experienced in changing the machine for differently-sized printing-rollers, as it is evident that in doing so, the bearings for the printing-rollers must be adjusted to bring the roller into contact with the periphery of the impression-cylinder. Heretofore the various adjustments were made separately and required considerable time and skill. The present machine is provided with a bracket fitted to slide in fixed bearings and carrying a printing-roller. A frame sliding on the bracket carries an apron. By means of a screw-rod an adjustment of the bracket in its bearings and of the frame on the bracket may be simultaneously effected.

FISHING REEL.—GEORGE O. BROSNAHAN, Jr., Pensacola, Fla. To permit a fisherman to wind up a line evenly on the spool and to enable him to stop the line at will when casting, this inventor employs a gear-wheel connected to revolve with his reel and adapted to be engaged by a swinging locking member in order to prevent the spool from turning in one direction. A spring acts on the swinging member to hold it in adjusted position. A crank-handle on the swinging-member enables the line to be readily wound up. A clutch mechanism connects the gear-wheel with the reel. By means of a finger-piece on a shifting-lever, the reel may be freed or locked at will.

STREET-SWEEPER.—ADAM C. A. DUPUY, New Orleans, La. In this street-sweeper a wheeled support is provided with independent compartments, each compartment having a section adapted to receive and hold refuse. A pocket-wheel adapted to take up stones is mounted to revolve in one of the compartments. A brush is mounted to revolve in the other compartment. The wheel and brush are located adjacent to the inlets of the receiving-sections of the compartments, so as to take up the dirt, dust, and stones. The brush and pocket-wheel are so constructed that they may be raised and lowered at will. In operating the machine but one man is required.

Railway Appliances.

TRUCK-LIFTER.—WILLIAM J. DONALDSON, La Grange, Tex. With the wheel and axle, the journal-box and frame of a car-truck are joined a flexible sling having grappling connections at its ends fastened at one end with the journal-box frame, and anchored at the other to move with the wheel in order to cause the rotary movement thereof to lift the journal-box from its bearing and simultaneously to hold down the wheel on the track. The invention is especially designed to be applied to loaded or empty freight-cars. The inventor states that, with this device, a truck can be lifted in but a fraction of the time formerly required. No screw-jacks, bars, or blocks are used. Manual labor is saved by causing the engine to do all the work.

CAR-COUPLING.—JOHN M. LARKIN, Union, S. C. Connected with a chambered draw-head and with a jointed coupling-link securable therein, is a buffer-block at the front end of the draw-head, having a laterally-widened transverse slot through which the link passes, the joint being located in the slot and being thus adapted to flex laterally. The coupling, it will be observed, is of the link-and-pin type, and is designed to take up shocks when two cars are brought together, and to permit a free lateral movement of the link when two coupling draw-heads are connected therewith.

TRACK-CLEANER.—LEONIDAS R. SHELL, Richmond, Va. The tool provided by this inventor is mounted to swing toward and from a track and to project into the grooves, so that as the car moves along, snow, ice, and dirt will be removed. The cleaner consists of a rigid plate to which a scraper is attached, projecting downwardly. A flexible sheet is secured against the plate and has a brushing-tongue extending down at the rear of the scraper. A backing-plate is secured against the flexible sheet and has a downwardly-projecting tongue reinforcing the brushing-tongue. The scraper advances through the groove, dislodges foreign substances, and is then followed by the brushing tongue.

BLOCK-SIGNAL SYSTEM.—WILLIAM L. STOCKTON, Trenton, Ohio. This block-signal system for electric railways provides a lamp at each end of the section. At the ends of the section, turnout track-switches are located. The wiring is so arranged that the lamp-circuit may be energized from the main current operating the car. A simple switch is also provided, which operates to close the lamp-circuit while the car is on the section between the track-switches, and to open the lamp-circuit when the car is on either one of the track-switches.

Miscellaneous Inventions.

BALL-CASTER.—ALPHONSO H. COBB, Asheville, N. C. This caster is composed of a body having a flanged socket containing three balls. A stud is passed between the balls and is provided with a head to retain the balls in position. The article of furniture to which the caster is applied, being moved about, two of the balls will fall as soon as motion begins to the rear, until they bring up upon the outer rim of the socket. Friction will then be exerted upon the walls. The third ball works loosely because of space in front and overhead.

PESSARY-APPLIER.—EDWARD A. BUTLER, Prescott, Arizona Territory. The applicator of this inventor comprises a barrel having one end beveled and flanged. A piston working in the barrel is provided with a packing and with a head beyond the packing. The head is in the form of a truncated cone having its sides inclined toward the beveled end of the barrel.

TILE AND TILE SETTING.—CHARLES C. ALEXANDER, Bayonne, N. J. Two methods are employed in setting tiles, known in the trade as "floating" and "buttering." In the first method, the bed of cement used often cracks. In the second method, interstices are formed which harbor vermin and moisture. It is the purpose of this invention to provide a tile free from these faults. The tile in question is formed on its back edges with an annular rabbet, leaving a projection embedded in the cement, the rabbet being completely filled with the cement. When the cement shrinks, a pressure is exerted by portions thereof in an inward direction against the rabbeted edges, and thus the tile is securely gripped on all sides. The air is expelled during the setting process. Each tile is independent of its neighbors for support.

UMBRELLA RIB-TIP CUP.—JOHN ALLESINA, Portland, Ore. This cup consists of an inner sleeve arranged to slide on the stick, and an outer sleeve rigid with the inner sleeve. The outer sleeve is formed so that it shall be of uniform diameter from end to end, is arranged to slide on the handle, and projects beyond the lower end of the inner sleeve, thus forming a channel for the reception of the rib-tips when the umbrella is closed.

TENT.—HENRY O. FLIPPER, Nogales, Arizona Territory. A simple, light tent has been patented by this inventor, which tent is made of one piece of material. The canvas or other cloth used may be divided and two shelter-tents made therefrom, it being possible for the divided material to be brought together to form a pyramid tent, which may be opened at the front and at the back. When taken down, the tent may be carried by two men, although capable of sheltering four. The canvas is so shaped that it may be used as a wagon-sheet, as a blanket, or as a pack-covering, by hunters. When the tent is erected, portions of the material may be carried within to form a covering for the ground.

WAGON-BOX CLAMP.—MACK A. LEITER, Sadorus, Ill. Connected with a bolster and a standard thereon, are braces running from the bolster to the standard. An arm extends through the standard and through the braces and projects from both sides of the standard. Clamping-rods pass through holes in the arm and have hook upper ends. Nuts on the rods engage against the under side of the arm. As the arm is held in the standard and the braces, it is evident that the clamping-rods can be drawn down tightly on screwing up the nuts, without danger of breaking the bolster-standard.

Designs.

DUST-GUARD SECTION.—JAMES S. PATTEN, Baltimore, Md. Two design-patents were granted to this inventor. The first design has as its leading feature a plate with a curved edge and inwardly sloping grooves in the opposite edges. The second design consists of a plate having side arms, a curved surface at the base of the arms, and sloped ribs at the inner edges of the arms.

SKIRT-BINDING.—CYRUS L. SULZBERGER, New York city. The five designs of this inventor are the result of an improved process of manufacturing bias velveteen, by which the fabric is improved in appearance and durability, and receives an added stiffness without losing its flexibility, thus enabling it to serve as a dress-stiffener.

GAME OR PUZZLE-BOARD.—GEORGE S. O'FLYN, New York city. The puzzle provided by this inventor consists in turning over marked blocks of wood through one plane at a time, so that they shall finally rest in certain fields with their marked surfaces turned up.

MUFF.—MAX W. JUDENFREIND, New York city. On the muff-body of this design a pocketbook has been secured in such a manner that the wearer of the muff can readily open the pocketbook whenever she may so desire.

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References to former articles or answers should give date of paper and page or number of question.

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(7534) **J. T. asks:** 1. Can a whistle be heard as well in a fog on the sea as in clear weather? A. There is much more in this question than the mere presence or absence of fog. Nor can a whistle be heard in clear weather equally well at all times. Both in foggy and in clear weather there is a great difference in the loudness with which a sound is heard at the same distance at one time and another. 2. Has there been anything done to overcome the difficulty, apart from the search lights? A. Sirens are used in thick weather, whose tones can be heard much farther than lights of any sort can be seen. 3. What distance can an ordinary whistle be heard? A. The distances at which an ordinary steam whistle can be heard are variously stated, for the reason that they vary very greatly. It is also true that a whistle may not be heard at a certain distance, while at a greater distance from it in the same direction it is distinctly heard. For the whole subject of soundless zones and the effect of fog, rain, snow, etc., upon sound, see Tyndall's "Sound," price $2 by mail.

(7535) **E. W. K. writes:** As a subscriber to your interesting paper, I would be glad to see in your columns the answers to these questions: 1. The 6 inch guns, like those of the "New Orleans," have about the same penetration at the muzzle as our 8-inch guns, and can fire over six times as often. Are they six times as powerful weapons? A. The blow struck by an 8-inch gun has much greater energy than that delivered by the 6-inch gun; but the rapidity of fire of the 6-inch gun renders the total energy of the projectiles delivered by the 6-inch gun much greater in a given time. 2. Is it certain destruction to a ship to be torpedoed? A. No. The subdivision of the hull of a ship may confine the flooding to certain portions of the hull, and prevent the ship from sinking. 3. Is the fact that the fire from guns cannot be directed to any particular part of an enemy's ship, except at short range, an argument in favor of light rapid-fire guns? A. We think it is, decidedly. The 8-inch rapid-firer is an ideal weapon, able to penetrate heavy armor and capable of rapid fire. 4. How are the "Maine," "Missouri," and "Ohio" to be armed and armored? A. We shall shortly publish an illustrated description of these ships. 5. Are their guns to be as high powered as those of the British ships? A. Probably more so. 6. How is it that the Brown gun, in sending its shots about one and a half times as fast as those of the 10-inch navy gun, develops over twice the energy? A. The energy, the weight remaining the same, varies as the square of the velocity. The 10-inch navy gun, it should be remembered, was designed a dozen years ago; the Brown gun is a modern weapon of more recent date.

(7536) **G. M. T. writes:** 1. I notice in your issue of October 29 of the SCIENTIFIC AMERICAN, under the article "Work of Naval Bureau of Ordnance," a statement to the effect that the Navy Department has adopted a smokeless powder made from soluble nitrocellulose by the Bureau's formula. Is the formula a secret of the Bureau or can you publish the same under your list of Notes and Queries? A. The formula is, we presume, for obvious reasons, a secret. 2. A second question I wish to ask is about the hardened plate for covering battleships. Can you inform your readers, through the same medium as above, how this plate is treated in the so-called "Harveyized" process? A. In the Harvey process the plate is placed in a furnace with only its face exposed. Carbonaceous material is then spread over the furnace, completely covering the face of the plate. After it has been subjected for a considerable length of time to a high temperature, during which the carbon penetrates the steel face, the plate is allowed to partly cool, after which the plate is uncovered and given an intense hardness by the application of cold water.

(7537) **H. I. W. writes:** I have a pair of plano-convex lenses of 5 inches diameter, 36 inches focus, and a Beck ¼ tintype lens, and I want to construct a lantern (for experimental purposes) like the one described on page 398, SCIENTIFIC AMERICAN, June 23, 1888, using acetylene gas as an illuminant. 1. What alterations will be necessary, if any, using the above mentioned material? A. No alterations will be necessary, except such as will adapt the lantern to the long focus of your condenser lenses. The usual focal length of a condenser for a lantern is 9 inches. Yours is 18 inches. You can arrange so as to move the lantern slide farther away from the condenser to a place where the cone of light is a little larger than the largest opening you will have in a slide. No changes are made necessary because acetylene is to be used. 2. Will the tintype lens have to have a rack and pinion for focusing? A. A rack and pinion is not essential. You can, in place of these, mount your lens on a board so arranged as to slide to and fro, thus securing the range of motion needed to focus on a screen at various distances from the lantern. 3. How far apart should the plano-convex lenses be placed? A. Place the condenser lenses close together. 4. Flat or curved sides together? A. The convex sides are to be toward each other. The plane sides are on the outer sides of the condenser. 5. How far from the front of condenser should the objective be placed? A. Determine the distance of the objective experimentally. It depends on its focal length and the distance of the screen. 6. How large a disk of light will 4¼ foot burners make, using acetylene, at a distance of 30, 35 or 40 feet? A. The size of the disk does not depend on the light used, but on the focal length of the objective, which you have not given. You can easily find this out for yourself when you get the lantern made. 7. Recommend book on photomicrography, also on optical projection and optical lantern construction. A. We can recommend Clark's "Practical Methods in Microscopy," price $1.75; Wright's "Optical Projection," price $2.25; and "The Magic Lantern," price $1. You will, however, find all you need, and much on other subjects in science, in Hopkins' "Experimental Science," price $4.

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AND EACH BEARING THAT DATE.

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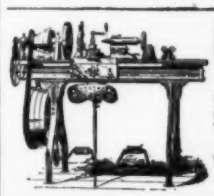

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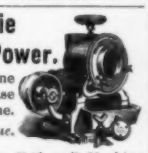

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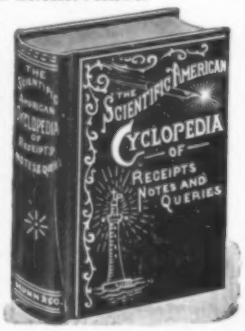

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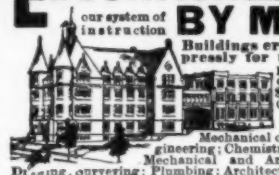

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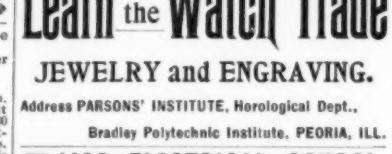
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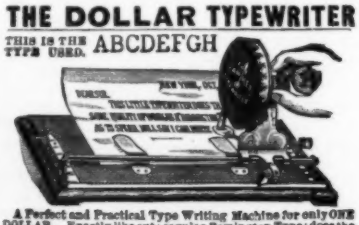

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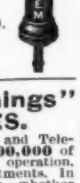

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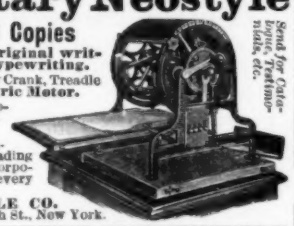

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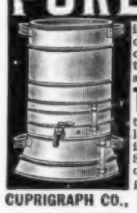

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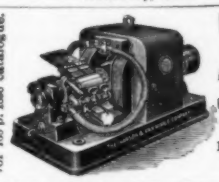

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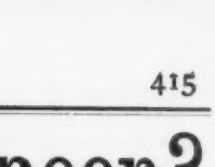

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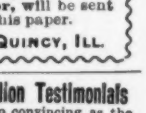

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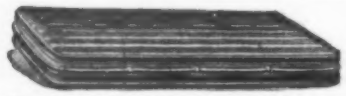

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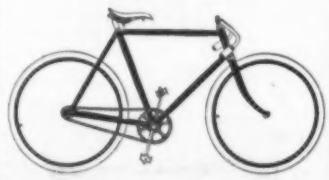

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